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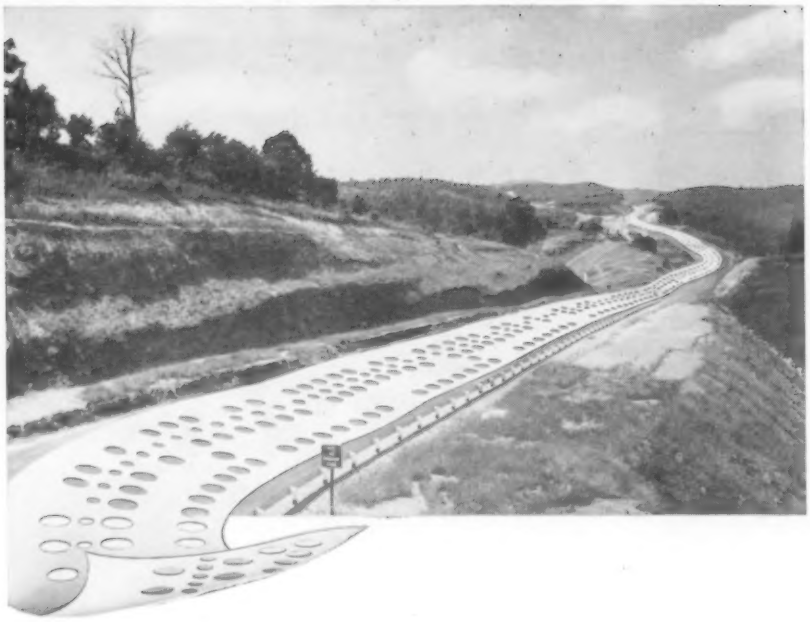
Quarterly Journal

AMERICAN CONGRESS ON SURVEYING AND MAPPING



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SURVEYING AND MAPPING is published quarterly by the AMERICAN CONGRESS ON SURVEYING AND MAPPING, Box 470, Benjamin Franklin Station, Washington 4, D. C. Yearly subscriptions to nonmembers: U. S. $5.00; foreign $6.00. Single copies $1.50 plus postage.

Entered as second-class matter at the Post Office at Washington, D. C., November 13, 1944, under the Act of March 3, 1879. Accepted for mailing at special rate of postage August 7, 1958. Additional entry as second-class matter at the Post Office at Lancaster, Pa.

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Editor-in-Chief

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Volume XVIII, No. 4

October–December 1958

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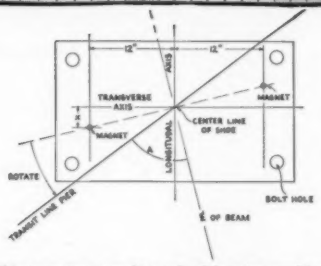

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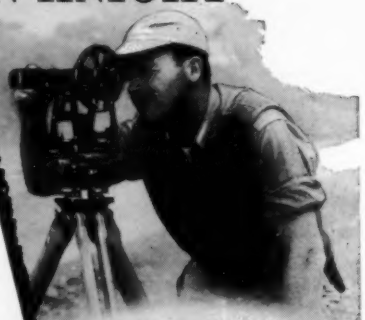

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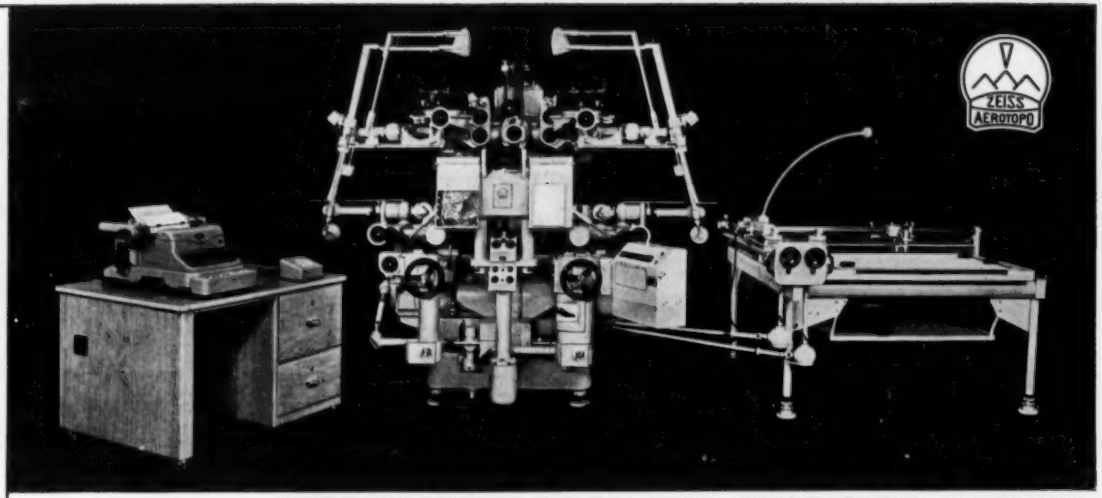

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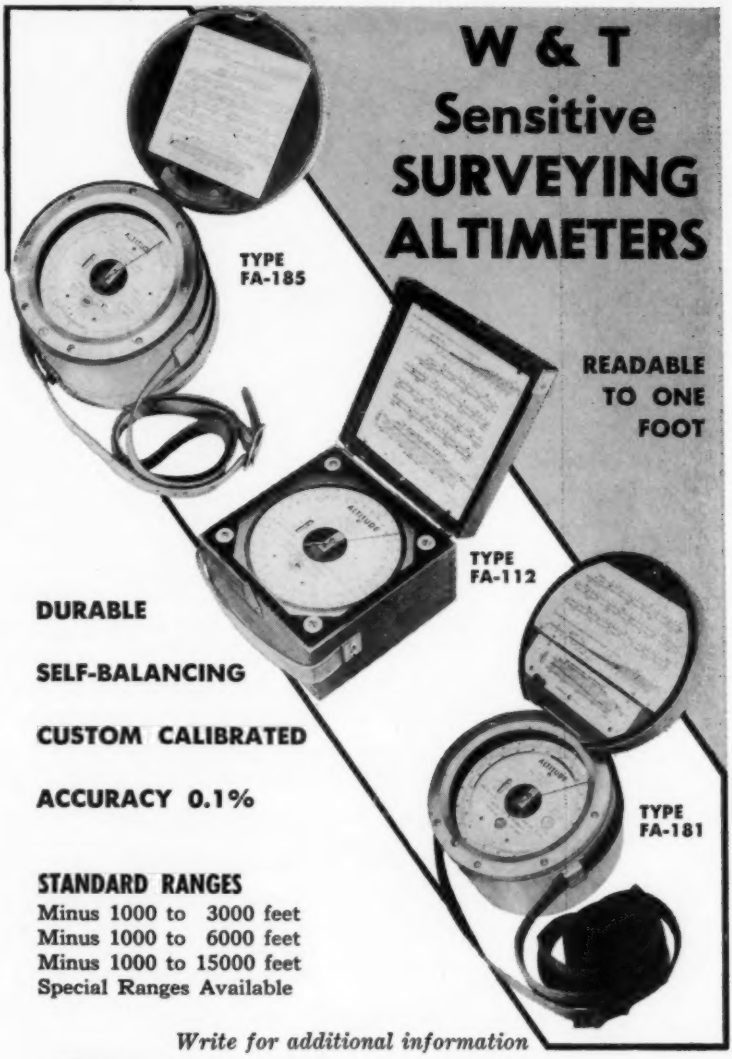
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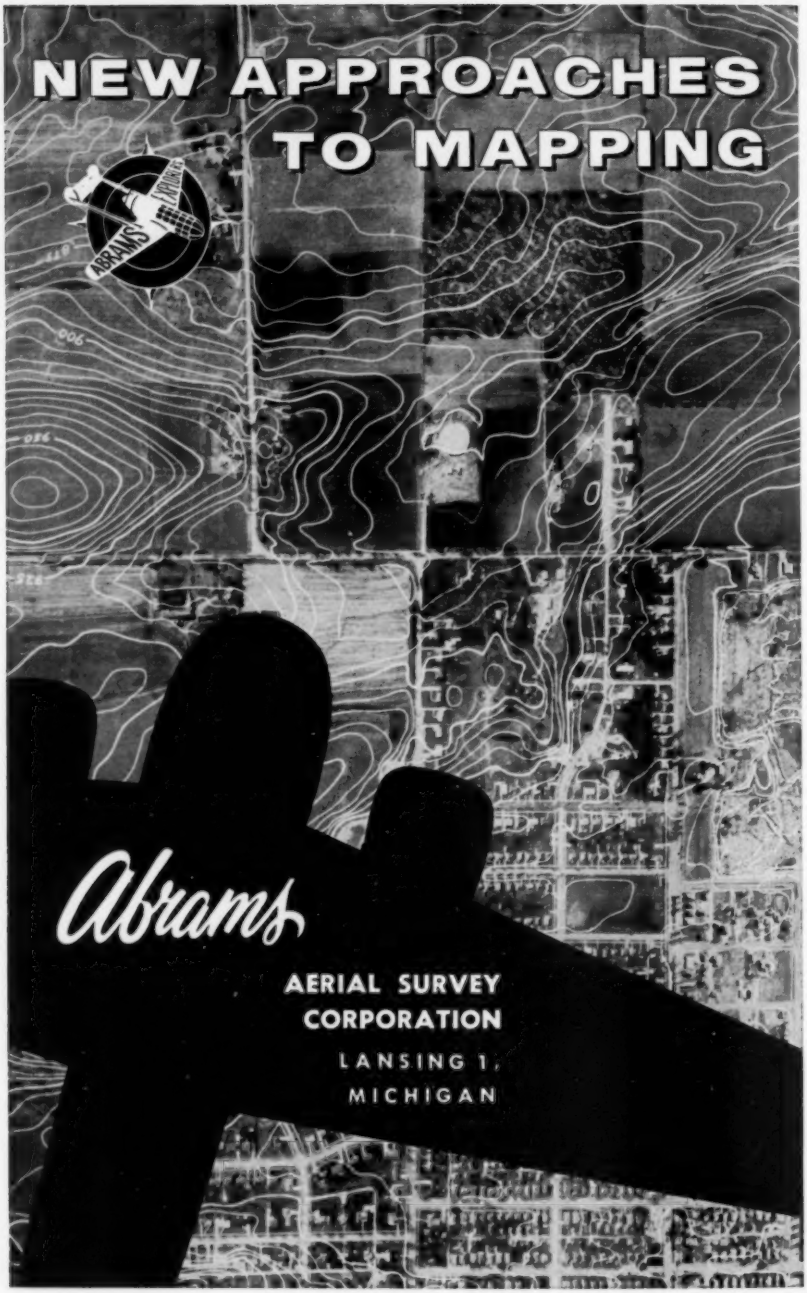
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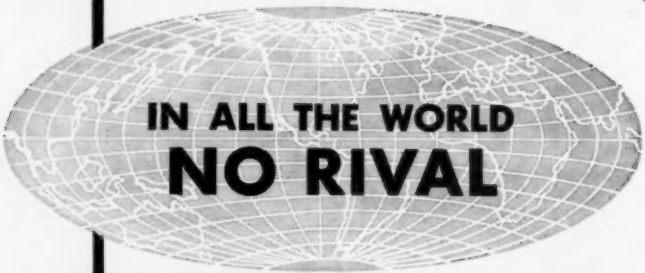

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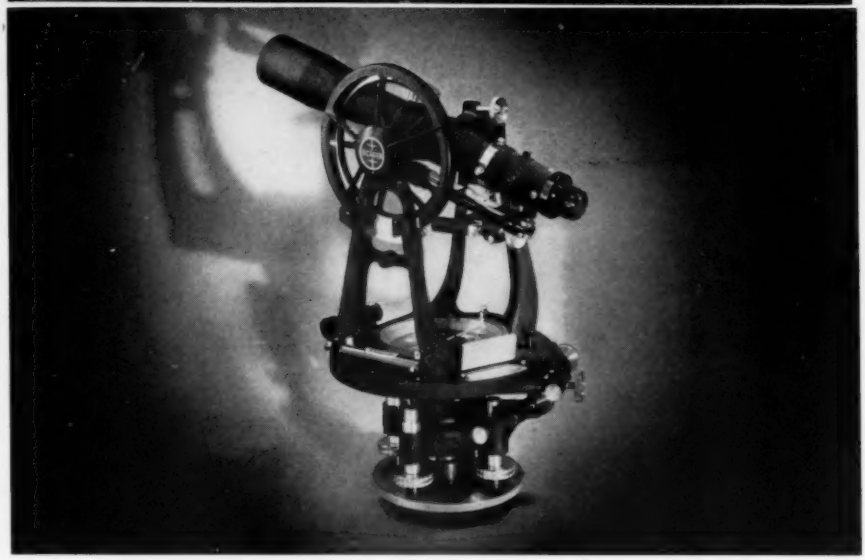

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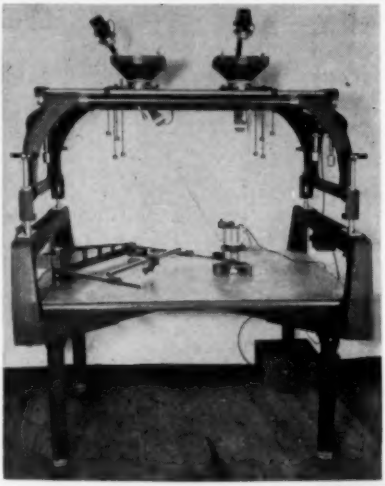

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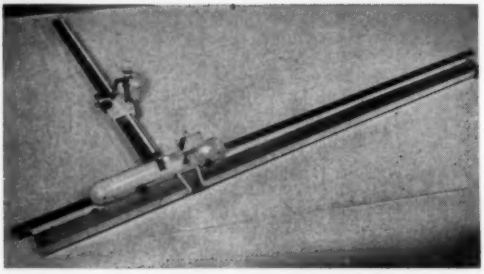

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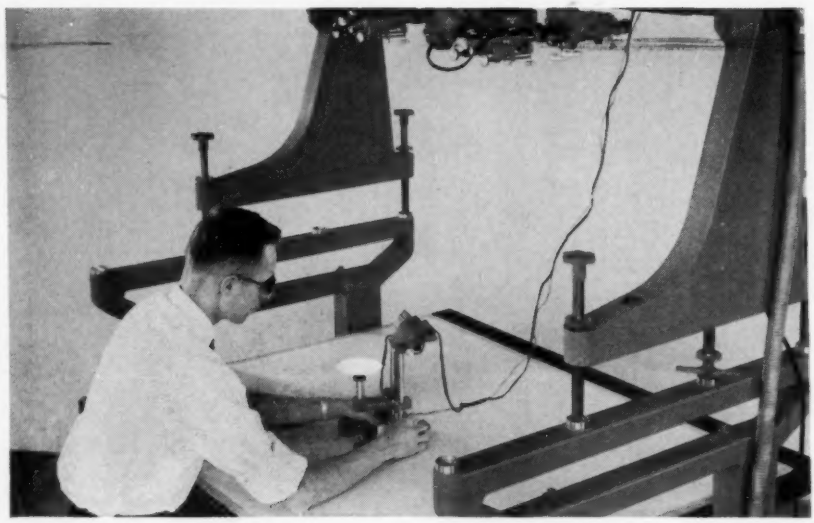

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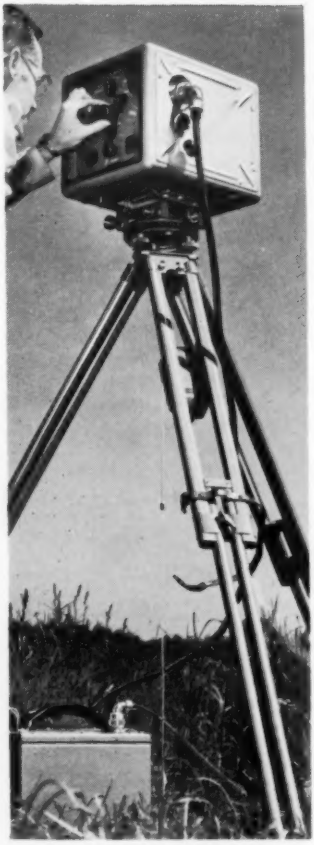

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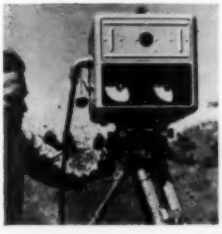

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Early Instruments in the History of Surveying: Their Use and Their Invention

By ROBERT P. MULTHAUF

SMITHSONIAN INSTITUTION

THE ANTIQUITY of surveying is well known, indeed surveying has been thought to have played a prominent role in the genesis of science itself. I refer to the reputed influence upon Thales—the Greek father of science—of the Egyptian surveyors who reestablished the land boundaries after the annual Nile flood—surveyors who must have enjoyed continuous and dependable employment to a degree scarcely equaled before or since. Historical investigation has not lessened our respect for Thales, but it has shown that he was a comparative latecomer to both science and surveying, which were practiced before 1000 B.C.—perhaps long before then—in Babylonia, Egypt, India, and China.

The most extensive testimony we have for the activities of these ancient surveyors is in the surviving evidences of their mathematics and, above all, in the remains of their architectural and civil engineering works, pyramids and other monumental structures, planned cities, and waterworks. The explorations of archaeologists, particularly during the last century, have revealed an astonishing production by these ancient nations, which continued through the heyday of the Roman empire.

Of the most ancient civilizations, only Egypt has left much direct evidence of the type of instruments used. For sighting and meridian determination the Egyptians used a plumb bob, which was observed through a slit cut in the end of a palm leaf.[1] For leveling they used a plumb bob suspended from a triangular frame, for right angle measurement a carpenter's square and a type of surveyor's cross called the groma (Fig. 1), and for direct measurement a

FIGURE 1.—Egyptian groma, reconstructed from a relic excavated in the Fayum district in 1899. (*See* R. W. Sloley, "An ancient surveying instrument," *Ancient Egypt,* 3 (1926) pp. 65–67.)

Presented at the 18th Annual Meeting of the American Congress on Surveying and Mapping, Washington, D. C., March 24–26, 1958.

[1] On the history of surveying, *see* Edmond R. Keily, *Surveying Instruments, their History and Classroom Use,* (New York: Teachers College, Columbia University, 1947); A. Laussedat, *Recherches sur les Instruments, les Methodes et le Dessin Topographiques* (Paris: Gauthier-Villars, 1898); and J. K. Finch, "Our Indebtedness to the Old Surveyor," *The Military Engineer,* July–August, 1925.

rope. Indirect measurements by the use of one or more vertical staffs were known, but it is uncertain to what extent they were used by surveyors, their principal use being by astronomers for meridian determinations and for telling time, as in the sun dial.

It is considered probable that the equipment of the surveyor in the other ancient nations was much the same, although the water level may have been known in China, and the use of cords stretched to form Pythagorean triangles occurred at an early date in India.

The Romans left descriptions of their instruments, and a few relics, which indicate that the instruments in common use were by and large refined examples of these earlier instruments, the principal addition being the water level.

Surveying activity in general seems to have declined in Europe during the Middle Ages, partially because of the method of land holding under the feudal system, which did not require many precisely surveyed boundaries. The Moslems of Africa and the Middle East were in this time the principal heirs of the ancient arts and sciences, but, although they made considerable contributions to the related fields of astronomy and astrology, the methods of surveying used among them appear, if anything, less sophisticated than those used by the Romans. The water level, for example, appears to have been abandoned in favor of the older plumb bob, nor does the groma seem to have been in use.

Among the Moslems the astrolabe, an already ancient instrument, was widely used in astronomy and astrology, and to some extent in surveying. Its real emergence as an instrument of common use seems, however, to have been in marine navigation. The same is true of the magnetic compass, which came to Europe about 1200, probably from the Far East. Although it may have found some use in surveying as early as 1300, it too comes into prominence in marine navigation. These were among the principal navigational instruments in Columbus' time, and many of the early reconnaissances of new lands from that time were made with marine instruments. Of particular interest is the famous astrolabe of Champlain (Fig, 2) now in the Museum of the City of New York, which was lost by the explorer in the St. Lawrence Valley, and found in 1870.

Among the numerous important developments which marked the waning of the European Middle Ages was the rise of geographical exploration. Reconnaissance surveying had of course always existed, but we know little of the methods, and the generally inaccurate character of ancient maps does not suggest that it was conducted with much instrumental aid. A famous school of geography arose in Lorraine in the late fifteenth century which was connected with important instrumental advances to be presently mentioned. Another school was established in Portugal at the same time, as that country was beginning its great period of exploration. The particular interest

FIGURE 2.—Champlain's astrolabe. Courtesy of the Museum of the City of New York.

of this group was navigational instruments, and, as we have noted, these were the instruments used in early reconnaissances in the Americas.

Very few actual instruments survive which can with any confidence be associated

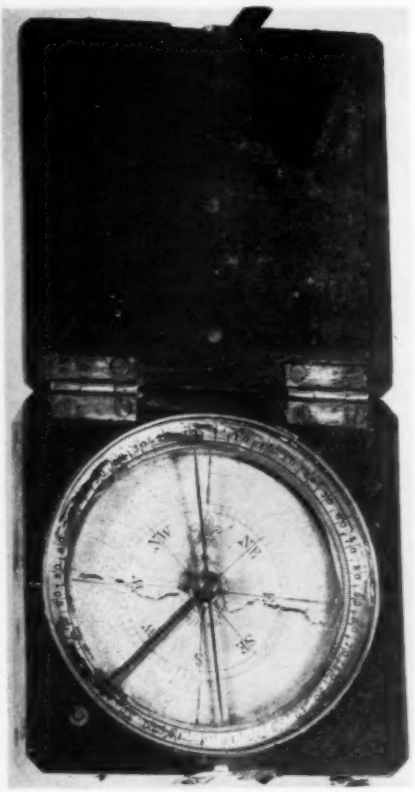

FIGURE 3.—Pocket compass used on the Lewis and Clark expedition, 1803–6. Smithsonian Institution.

with these surveys, although it is probable that a more widespread interest in the history of surveying might turn up a few. Figure 3 shows an instrument used on the Lewis and Clark expedition in the first decade of the nineteenth century. It is one of six compasses taken on the expedition, along with a sextant, Hadley's quadrant, a chronometer, ship's log, telescope, and drawing instruments.

The instrumental equipment of the explorer did not change much until the end of the nineteenth century. The sextant, pocket chronometer, barometer, artificial horizon, prismatic compass, and hypsometer have been mentioned as the typical equipment of the explorer from 1840 to 1890[2]. Figure 4 shows these instruments, not all from the same source, but approximating the equipment of this era. The latter three were introduced a little after the time of Lewis and Clark, the artificial horizon in 1804, the prismatic compass in 1812, and the hypsometer in 1817. From 1847 the aneroid barometer replaced the mercurial instrument.

The equipment of the typical topographic surveyor was no more elaborate. John Gummere's *Treatise on Surveying*, 2nd edition, published in Philadelphia in 1817, recommends the compass and chain for most measurements. For leveling he mentions only the plumb bob, for the measurement of inclines the quadrant, and for meridian determination the compass and a homemade staff combination. He notes that there are other methods, but as most of them require expensive instruments "it is thought unnecessary to notice them in this work." Later editions differ little although he does describe the theodolite by 1853.

The typical surveyor's compass of that time evidently existed in very large numbers, as many examples still exist today. Figure 5 is typical in form, but not in construction. It is an interesting example of the ingenuity of a rural surveyor who was evidently unable to procure commercial equipment. This compass was used in the eighteenth century by Joseph Frye, in laying out the town of Fryeburg, Maine. The compass and chain were the only instruments mentioned in the first instructions for deputy surveyors of the Public Lands, issued in 1815. The requirement for the use of the true meridian, which had been laid down when the survey act was passed, had been waived in 1786, and the use of the magnetic compass in this survey was not prohibited until the 1890's.[3]

I have attempted here to describe briefly

[2] E. A. Reeves, "The Mapping of the Earth," *Geographical Review*, 48 (1916) pp. 331–46.

[3] On the Public Land Survey, *see* L. O. Stewart, *Public Land Surveys, History, Instructions, Methods* (Ames, Iowa: Collegiate Press, 1935).

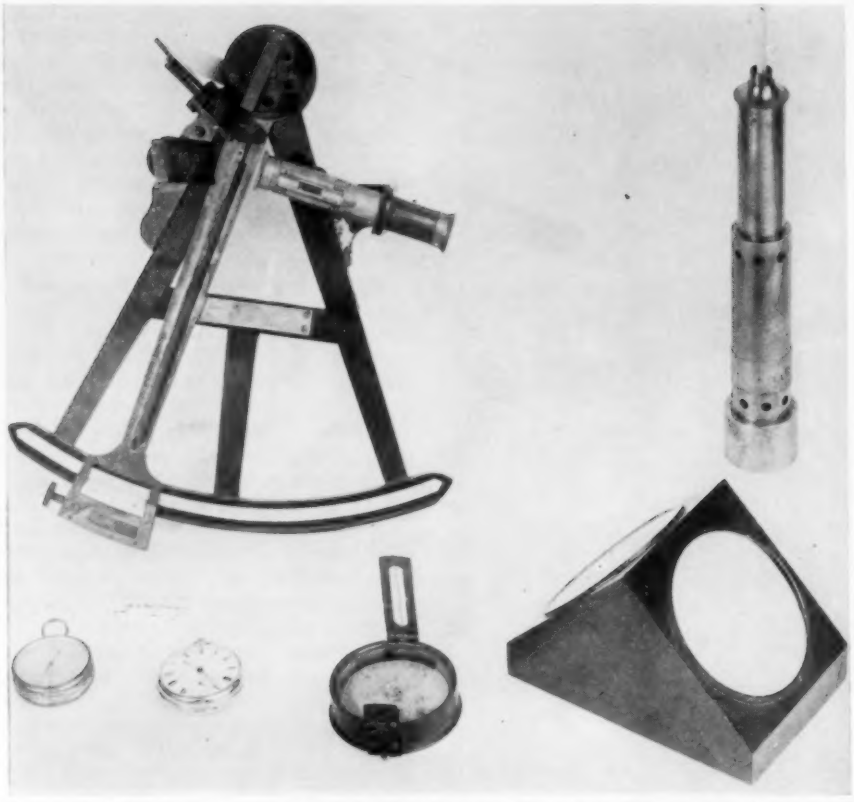

FIGURE 4.—Typical equipment of the reconnaissance surveyor, 1840–1890. Above, *left to right*, sextant and hypsometer; below, aneroid barometer, pocket chronometer, prismatic compass, and artificial horizon. All instruments in the Smithsonian Institution.

the equipment of the "typical" surveyor from the earliest times in the Old World and in the New World roughly through the first half century of the United States. Many instruments of greater complexity have been passed over, for the extent of their use by the ordinary surveyor is very questionable. But this is no longer true. At some time in the nineteenth century the equipment mentioned above ceased to be that of the typical surveyor, who entered a new era of accuracy made possible by new instruments. In order to explore the origins of this new era I propose now to delve briefly into the early history of some of these new instruments.

This exploration requires us to return nearly to the starting point of our story.

In the works of the Greek, Hero of Alexandria, a mechanically inclined geometer who lived shortly before or after the time of Christ, we find described an instrument which seems startlingly different from those common then and long after. This is his "dioptra" (Fig. 6), of which neither an example nor a drawing has survived, but which is tolerably well described and has been sketched by Schöne.[4] This instrument could be used either for laying off right angles or for leveling, as it has a water-level

[4] H. Schöne, *Herons von Alexandria Vermessungslehre und Dioptra* (Leipzig, 1903).

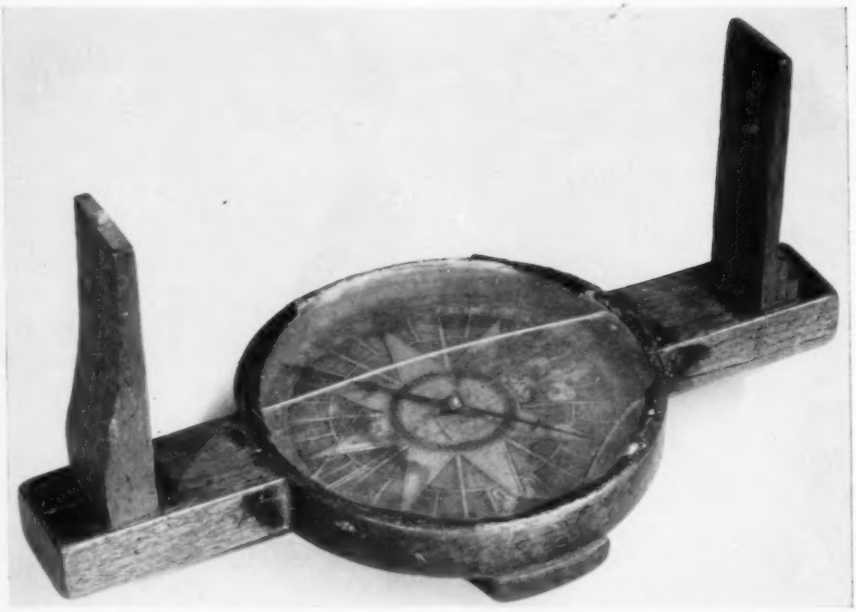

FIGURE 5.—Homemade surveyor's compass made by Joseph Frye about 1780. Smithsonian Institution.

attachment consisting of two transparent receptacles connected by a long tube. Used with it was a leveling rod which has been called "practically as good as the common type in use at the present day."[5] Hero lived in the period of Greek decline, and it is not clear that the dioptra was used very extensively, even by the Greeks. Skepticism has indeed been expressed that the ancient instrument maker could have built an instrument requiring such fine machine work, but we now have evidence in the form of a geared machine in the museum at Athens that they could, and it can no longer be said that "modern" techniques of machine design and construction were totally lacking before modern times.[6]

The Romans' apparent neglect of the dioptra in favor of the old groma may be an indication of the impracticality of the former, for the Romans were eminently practical. Interest in complicated instruments appeared again, however, among the Moslems, whose civilization spread across the old world from Persia to Spain in the wake of the Arabic religious crusade.

The Moslems have left many examples of the astrolabe which are quite different in appearance from the nautical instrument which has already been shown. The surviving examples, which are not early, relative to the history of the instrument, show the complexity of design and workmanship it attained in the hands of the Moslems. The front view (Fig. 7) shows the thick plate, suspended from the thumb by a ring, which is the base of the instrument. It is called the "mother." Its face usually carried a radial indicator, missing in this instrument, and beneath it the highly decorated "rete." The rete contains a circle, the ecliptic, on which are engraved the signs of the zodiac. Within its design are pointers representing the positions of certain fixed

[5] Keily, *Op cit.*, p. 25.

[6] *See* D. J. Price, "The Prehistory of the Clock," *Discovery* 17 (1956) p. 157.

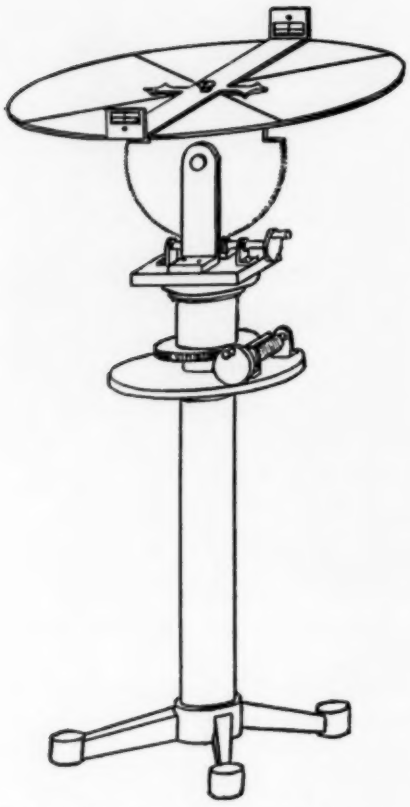

FIGURE 6.—The dioptra of Hero of Alexandria, as reconstructed by Schöne. (*See* note 4).

stars. Beneath the rete are a series of circular plates which fit into the mother and can best be seen in the disassembled view in Figure 8. Each of these is engraved with a stereographic projection of the sphere for use in a special latitude. Thus far all relates to astronomy and astrology, but on the back (Fig. 9) appears a device more familiar to the surveyor, an alidade moving over a plate on which are inscribed circles and on the lower half a shadow square. The shadow square, introduced by al-Battani about 900 A.D., was a geometric construction which permitted the use of the instrument in calculations involving similar triangles.

The astrolabe was used as a timepiece, in making astronomical and astrological measurements, and in navigation and surveying. Most surviving examples are works of art, and suggest that its function as an ornament was not its least important use. Like the dioptra of Hero, the Arabic astrolabe is a monument in the history of fine instrument making. In the Rennaissance this art passed to Europe and these decorative astrolabes were joined by other instruments, compasses, sun dials (Fig. 10), and various composite instruments, which are today found in museums in considerable numbers, testifying to the conjuction of science and art which characterized that period.

The popularity of science in this age reflected more utilitarian interests, however, and saw a conjunction, in the field of astronomy, between the instrument maker and the scientist. The first great landmark in the history of the *precision* instrument seems to have been the work of the Danish astronomer Tycho Brahe, at the end of the sixteenth century. Brahe, having the objective of a more accurate star catalogue than the ancient ones then in use, undertook to devise and construct a group of instruments capable of yielding this result. Through many years of painstaking observation he succeeded in preparing a new catalogue, the accuracy of which enabled his successor, Kepler, to revise the laws of planetary movement. Although it is questionable that any of his instruments survive, he has left a book of illustrations which show that they were scarcely less ornate than the other contemporary ornaments of the instrument makers' art.[7] But they were intended for a serious scientific purpose and the results of his work testify to their accuracy.

The instrument shown in Figure 11 is a copy of one still existing, in the Landesmuseum at Kassel, Germany. Kassel was the capital of a German principality whose Sovereign was interested in science, and Brahe spent some time there. Although

[7] *Astronomiae Instauratae Mechanica* Wandesburgi, 1598).

FIGURE 7.—Seventeenth century Indo-Persian astrolabe, front. Smithsonian Institution.

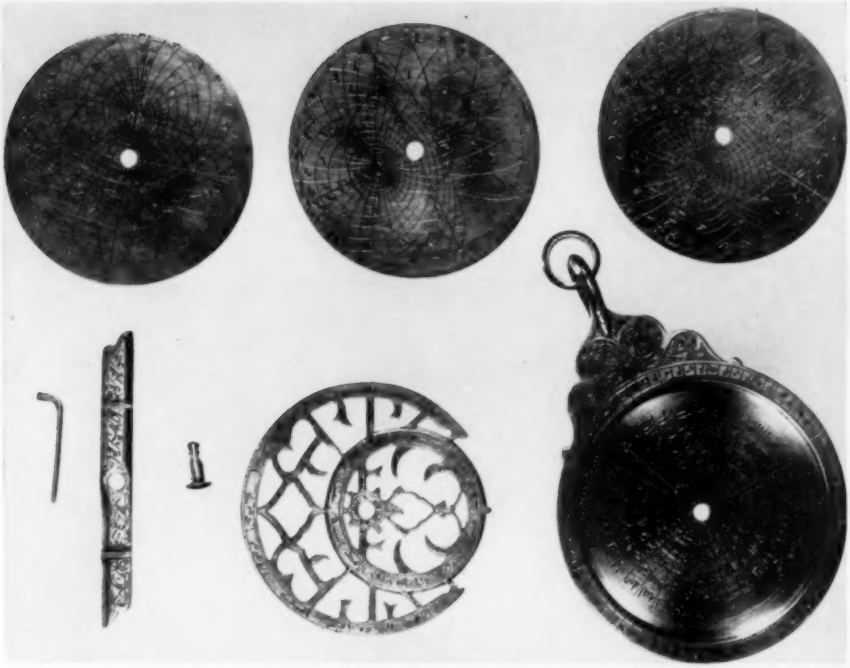

FIGURE 8.—Nineteenth century Persian astrolabe, disassembled. Smithsonian Institution.

it lacks the aesthetic qualities of most of Brahe's instruments, this one does exemplify the new type of large and versatile instrument which was to revolutionize observational astronomy.

Similar instruments for surveying existed at this time, at least on paper. Martin Waldeseemuller of the Lorraine school of geographers left a drawing of an instrument, which he called the polymetrum, recognizably the ancestor of the theodolite. From his time we find a series of such instruments with similarly exotic names illustrated in books on surveying. One of these was the "theodolitus" of Leonard Digges, which name became attached to the instrument shown on the title page (Fig. 12) of Rathborne's book of 1616. These too became grist for the mill of the maker of decorative instruments, as shown by the theodolite (Fig. 13) of Jean Dupuis, now in the Conservatoire National, Paris. But the rise of geodesy in the seventeenth and eighteenth centuries, and with it the practice of triangulation, created a demand for instruments adaptable to this new technique. The most important of these were the theodolite, circumferentor, and plane table. The theodolite long retained the general appearance of the instrument illustrated by Rathborne, as shown by the instrument which was used in 1818 (Fig. 14) by John Johnson, in surveying the Canadian border with the State of Maine. The circumferentor was an outgrowth of the astrolabe, which was placed in a horizontal position, mounted on a staff, and finally carried a compass. Such an instrument was used by Mason and Dixon in their American survey.[8] It is now

[8] The name circumferenter has been loosely used. As used here it refers to the circular, astrolabe-shaped instrument, mounted horizontally and carrying two sets of sights, one fixed and the other mounted on an alidade. It usually carries a compass in the center.

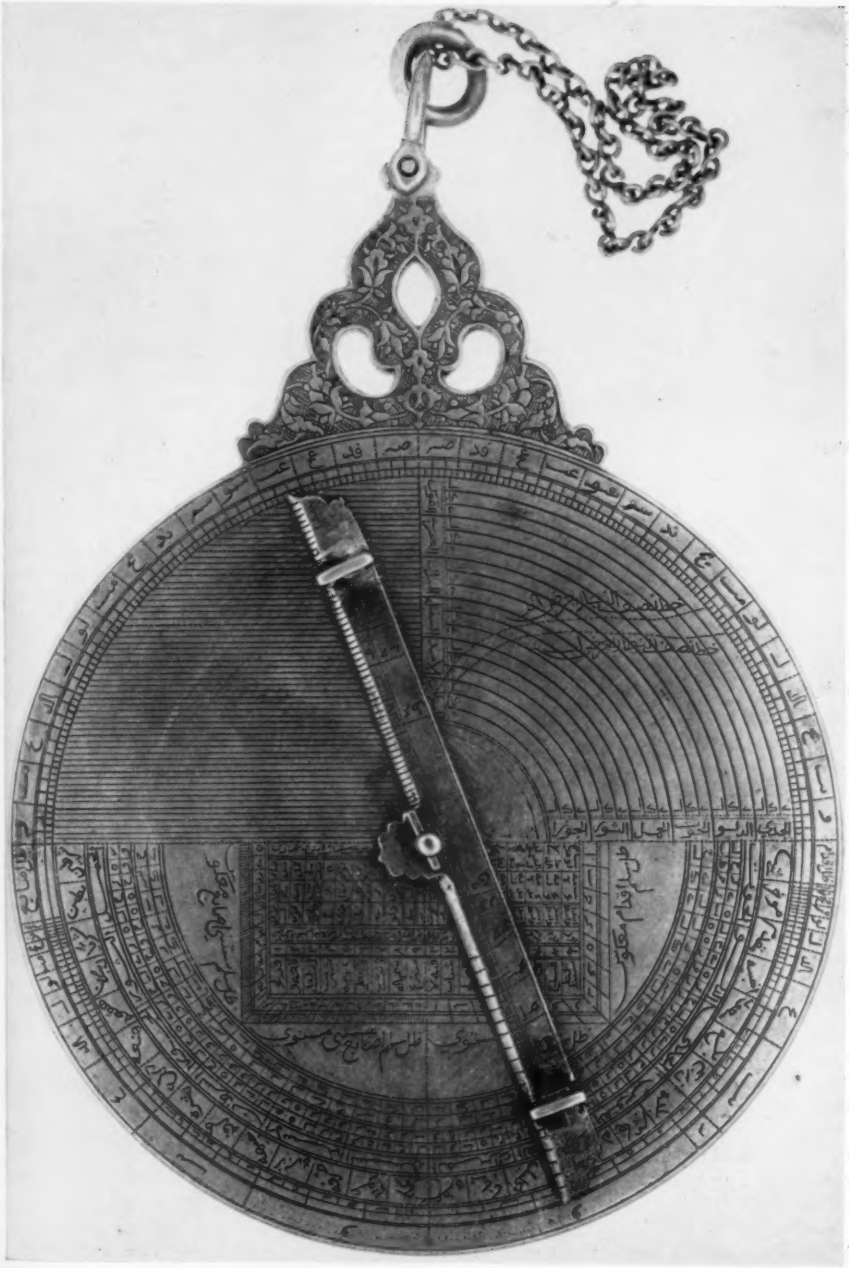

FIGURE 9.—Seventeenth century Indo-Persian astrolabe, back. Smithsonian Institution.

FIGURE 10.—Universal equinoctial sun dial, about 1770, made by G. F. Brander of Augsburg. Smithsonian Institution.

in the Royal Geographical Society, London. These seem to have been somewhat "aristocratic" instruments and are rarely mentioned except in connection with projects of considerable importance. The plane table had a more humble history, it was originally spelled p-l-a-i-n, and so named because of its simplicity as compared to such instruments as the theodolite. But the extent of its early use, at least in this country, is questionable, although it ultimately achieved great popularity here.

While these developments were occurring among the surveyors, the astronomers continued the refinements of observational instruments begun by Brahe. He had begun the construction of instruments of metal rather than wood, and applied to the scales the "nonius," a system of concentric scales of different divisions which aimed—with only moderate success—to improve the readability from 1 degree to 10 minutes. In the seventeenth century this was replaced by the vernier.

Also in that century the modern attachments for reading scales, leveling, and telescopic sighting gradually came into use in astronomy. Their introduction was slow, however, and their adaptation to surveying instruments even slower. This was partly due to the conservatism of users, but also to the fact that the use of these complicated and expensive instruments did not improve the accuracy of the surveys sufficiently to warrant their general use. In the inevitable inaccuracy of hand-divided circular scales, a limitation which bothered the astronomers less than the surveyors because of their ability to use large stationary instruments, a defect appeared which the best effort of the instrument maker seemed unable to overcome.

The real flowering of the theodolite and derivative instruments dates from the work of the English instrument maker, Jesse Ramsden, in 1775. Inspired by the proposal for a trigonometrical survey of Great Britain, Ramsden devised a screw cutting lathe (Fig. 15) with change gears, which enabled him to cut screws of any desired pitch from a master lead screw. With this lathe he made a hob for the cutting of the precision worm wheel on a circular dividing engine (Fig. 16), and with this machine he in turn produced the circular scale for a large theodolite (Fig. 17). The lathe and dividing engine, which are now in the

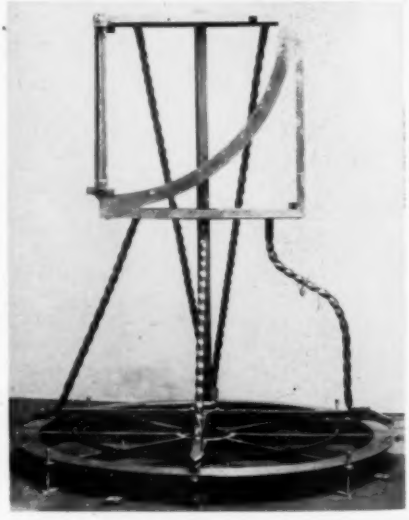

FIGURE 11.—Replica of a late sixteenth century astronomical quadrant in the Landesmuseum, Kassel, Germany. Smithsonian Institution.

FIGURE 12.—Title page of *The Surveyor*, by Aaron Rathborne (London, 1616). The drawing above shows the theodolite, that below shows the planetable.

FIGURE 13.—Theodolite of Jean Dupuis, 18th Century. Courtesy of the Conservatoire National des Arts et Métiers, Paris.

Smithsonian Institution, and the theodolite, now in Science Museum, London, show that by this time the era of precision instrument making had arrived.

The new era was almost immediately reflected in the United States. By the end of the eighteenth century our own academy of science, the American Philosophical Society, was not only conversant with the new European instruments for astronomy and geodesy, but some of its members, notably David Rittenhouse and Andrew Ellicott, had successfully built such instruments. Ellicott was particularly interested in geodesy, which had been built into a formidable science by the European academies in the eighteenth century. Using instruments chiefly of Rittenhouse's construction, but partly of his own, he participated in such surveys as that of the District of Columbia, and the border with Spanish Florida. Figure 18 shows the most complicated of these, a zenith sector. This instrument, which predated the accurately divided circle, represented an attempt to attain greater accuracy by the observation of stars only near the zenith, through the longest

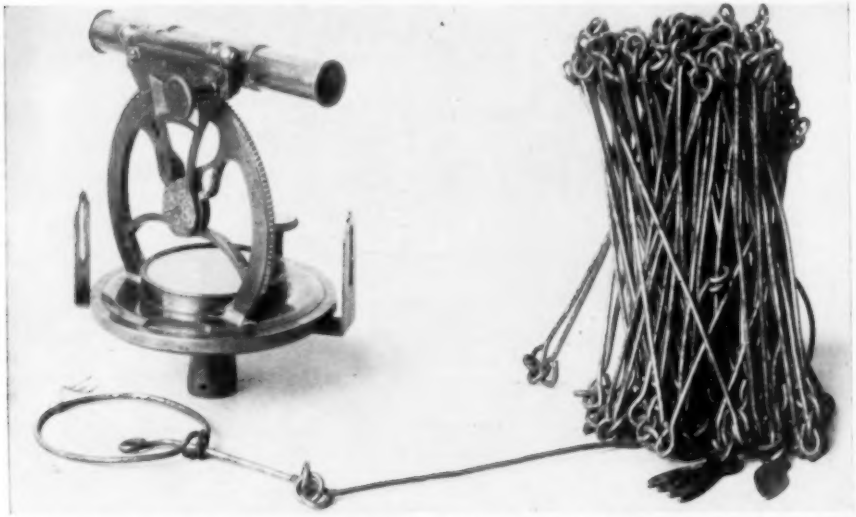

FIGURE 14.—Theodolite and chain used by John Johnson on the border between Canada and the State of Maine, 1818. Smithsonian Institution.

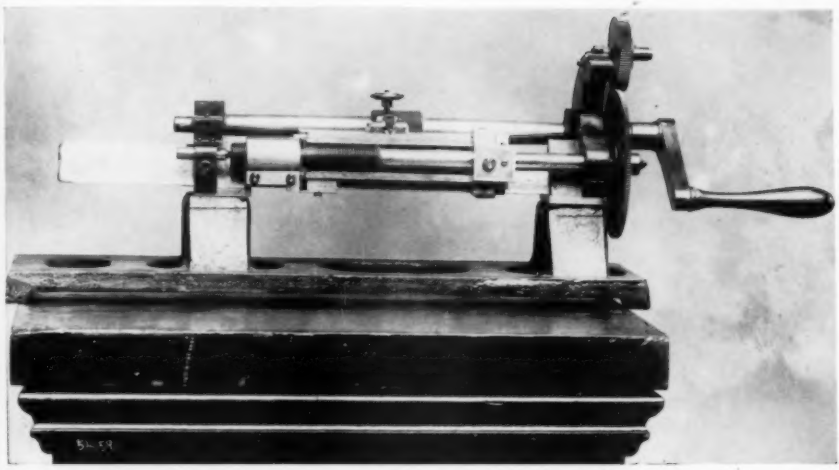

FIGURE 15.—Ramsden's screw-cutting lathe with change gears, 1775. Smithsonian Institution.

telescope which could be conveniently used. Its scale was thus a small segment of a very large circle.

With the foundation of the Coast Survey in 1818 the Government entered officially upon the business of scientific geodesy. Ferdinand Hassler, a Swiss emigrant and an experienced geodesist, immediately undertook to begin this survey on the highest scientific level. He designed the instrument shown in Figure 19, an improvement on Ramsden's great theodolite, and had it built in England. Unfortunately it no longer exists, so far as we have been able to determine. From its outset the Coast Survey relied on instruments of this caliber, and their improvement from the time of Ramsden was nearly continuous.

It is questionable to what extent these developments influenced the work of the ordinary surveyor prior to about the middle of the nineteenth century. Rittenhouse was engaged at an early date to make a standard chain for the survey of the public lands, and some attempt was made to use geodetically established meridians, but we have noticed that this was abandoned at at early date, because of the difficulty of the terrain. An Act of 1850 authorized the Secretary of the Interior "if he deems it advisable," to continue surveys of Oregon and California "after what is known as the geodetic method," but the true meridian was not universally used until 1894. The Coast Survey, until 1878 when it became the Coast and Geodetic Survey, was largely restricted to the areas signified by its name.

These geodetic enterprises were undoubtedly influential in improving the methods of the ordinary surveyor. Accounts of early surveying in this country make it clear, however, that the ponderous instruments of the geodesist were a trial in rough country, and they seem to have been scarcely more significant in the work of the ordinary surveyor than Hero's dioptra was in that of the Roman surveyor. The most important effect of geodesy on the methods of the surveyor was in the awareness it gave him of precision methods, and in the impetus it gave to the business of the instrument maker. These two factors ultimately led to the invention of certain precision instruments especially designed for his use. Such were the surveyor's transit, a modified theodolite, developed by William Young of Philadelphia in 1831, and the solar compass, invented by a surveyor, William Austin Burt of Michigan, in 1836. Figure 20 shows the solar compass as it appears on

FIGURE 16.—Ramsden's circular dividing engine, 1775. Smithsonian Institution.

the patent, one of the few which have been restored after the fire which occurred a few months after Burt's filing. This instrument, in which an attachment for obtaining the true meridian was added to the ordinary compass, was recommended to the surveyors of the Government Lands as early as 1855, and ultimately became a piece of standard equipment. It represents an instrument of complexity comparable to those used in astronomy and geodesy, and can be taken to mark the end of the period when the great majority of surveyors proceeded about their necessary business relatively independent of the contemporary currents of science and technology.

Historical accounts of surveying tend to dwell at length upon instruments like Hero's dioptra, which appear to have entered little into actual surveying and to belong rather to the history of the invention of scientific instruments. In this connection they are immensely interesting, especially to our gadget-loving age, but, if this analysis is

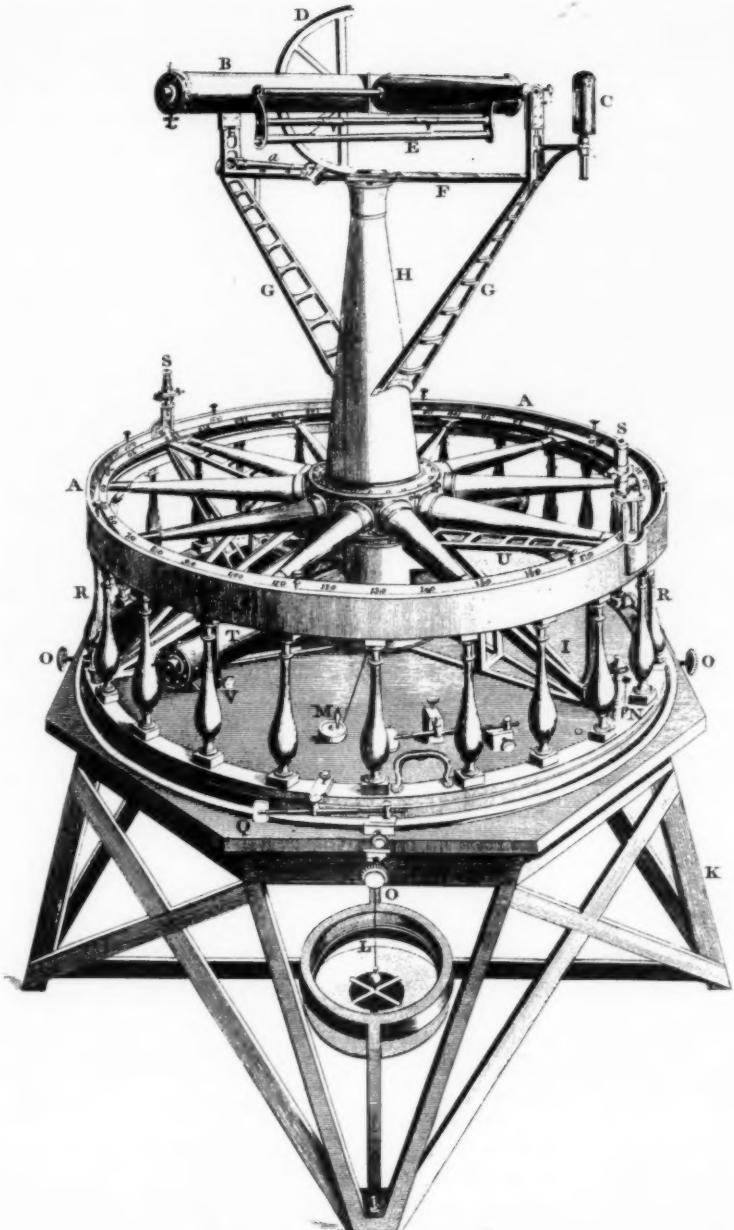

FIGURE 17.—Drawing of Ramsden's 3-foot theodolite, made in 1787–90 for the trigonometrical survey of Great Britain. The two original instruments are now in the Royal Society and Science Museum, London.

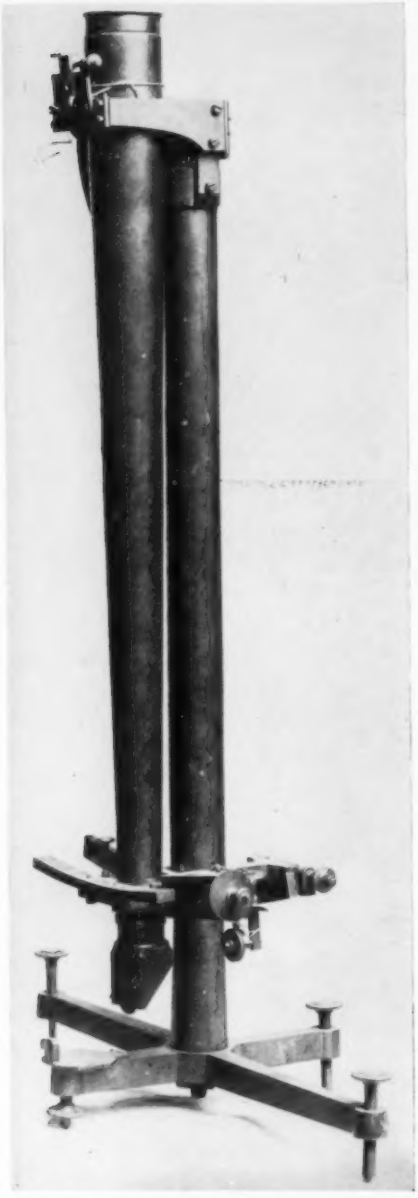

FIGURE 18.—Ellicott's zenith sector, made by David Rittenhouse about 1785. Smithsonian Institution.

correct, to give a prominent place to such instruments in the history of surveying is to give a false picture of the surveyor during those many centuries when the art was developed. Not the least defect resulting from this practice is the fact that it obscures the credit due the heroic surveyor of former times, who laid out the pyramids, the cities of Europe, and eventually mapped the world, with primitive apparatus which is now virtually unknown.

From another point of view, the study of the history of such instruments as the dioptra and astrolabe for their own sake raises a number of interesting questions which I have only been able to suggest here. As it appears possible that ideas and techniques equal to the design of "modern" instruments existed many centuries ago, what prevented their introduction—the lack of general education in mathematics?—economic considerations?—the lack of machine methods of inscribing lines? The question cannot be answered within the brief scope of such a paper as this, and will in any case remain to some degree conjectural. But it should be inquired into, for our present dependence upon invention makes it essential that we attempt to increase our understanding of the relationship between the inventor and his public.

(Figures 19 & 20 are on the next two pages)

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THE BIG Z

"The Big Z," a motion picture completed early this year by the Ontario mines department in cooperation with some of the mining companies active in the area where twelve uranium mines are now in production, is a full color film which tells in graphic detail the story of events that transformed the Elliott Lake area of Ontario from primitive bushland into the busiest mining area in Canada in less than five years.

The film is loaned by the Department of Mines without charge to schools, clubs, mining and investment groups, and other organizations. The National Film Board has copies of the film in its offices in the United States to handle requests from groups in this country.

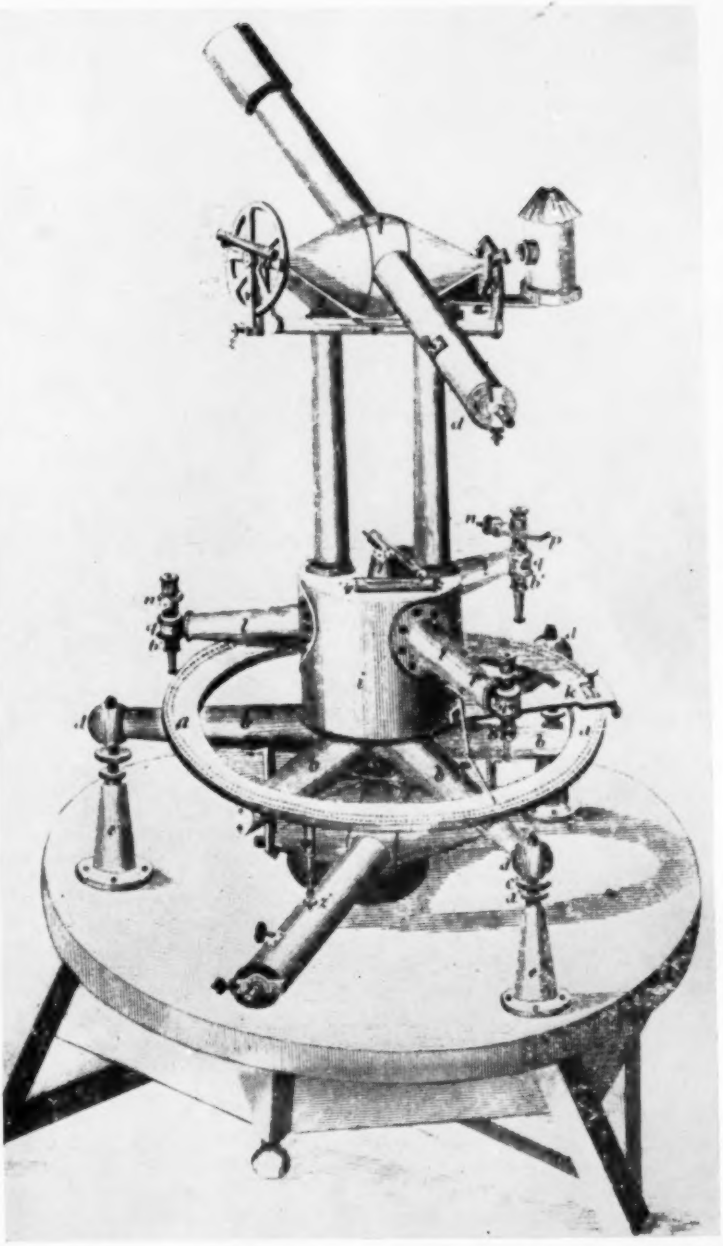

FIGURE 19.—Drawing of the first large theodolite of the U. S. Coast and Geodetic Survey. Designed by Hassler and made by E. Troughton, London, in 1815.

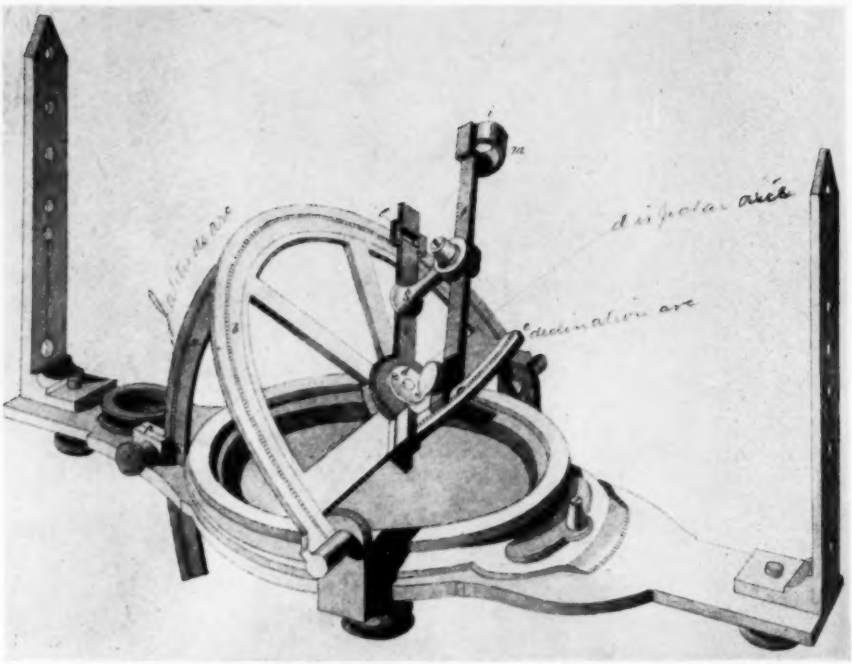

FIGURE 20.—Patent drawing of the Burt solar compass, 1836. From the restored patent drawings in the National Archives.

R. P. I. Inaugurates Twelfth President

ACSM's past president Lester C. Higbee represented the American Congress on Surveying and Mapping at the inauguration of Richard Gilman Folsom as the twelfth president of Rensselaer Polytechnic Institute, at the R. P. I. Field House, Troy, N .Y., October 4, 1958.

Those assembled for the luncheon were addressed by the Hon. Averell Harriman, Governor of New York. The academic procession took place at 2:30 p.m. The inaugural ceremony was held at 3:00 p.m. The speakers were, Robert Gordon Sproul, President Emeritus of the University of California, and Richard Gilman Folsom, the new president of R. P. I.

A general reception followed the ceremony.

Maine Coast Charting Program

A long-range program for the complete reconstruction and modernization of the series of 1:40,000 scale charts covering the coast of Maine has resulted so far in the production by the Coast and Geodetic Survey of three new editions of the nautical charts. These are Nos. 303, 304, and 305, and together they cover the coast between West Quoddy Head and Schoodic Island.

It is interesting to note that Maine has a detailed tidal shoreline of 3,478 miles. Florida is the only State having a detailed tidal shoreline of greater length than that of Maine. Maine's entire coast is subject to tides of unusual range, and tides of 18 feet or more occur periodically.

Surveying Safety on the Highway

By THEODORE S. PATTISON, JR.

PROFESSIONAL LAND SURVEYOR, SEATTLE, WASHINGTON

"CAR KILLS MEMBER OF SURVEY CREW—SECOND MAN BADLY HURT." This was a headline in the Seattle *Post-Intelligencer* on Febraury 28, 1958. Such sad news about fellow surveyors did not surprise me, as I have had too many close calls myself.

A crewman on a combat ship in a war zone has a safer job than the surveyor working on a highway or city street. I feel that we, as surveyors, should fight for safety continually. A long range aim would be to have the survey monuments or control points located on sidewalks or on the road shoulders. I understand that efforts have been made by some cities and States to make such relocations. A second *must* is to educate the driving public to the necessity for extreme caution when they see men working in the street. This boils down to reducing speed to 15 mph or less, and giving the surveyor or other street worker plenty of leeway. I believe that too many drivers are criminally ignorant of their obligation.

As a private surveyor, working with one or two other men, I endeavor to apply the following safety practices:

1. Offset, and work the sidewalks or shoulders where possible and practical.
2. Select a time when traffic should be slack.
3. Use plenty of flags. (Mine are fifteen-inch square red flagging, set in a red painted base—cheap to make, and expendable.)
4. Proper location of flags. (On a two-lane highway my flags are placed to insure a safety lane of six feet in which to work. Six hundred feet from each end of the safety lane a flag is placed on the centerline; at four hundred feet a flag is placed 2 feet off center into the lane of approaching traffic; at two hundred feet a flag is placed 3 feet off center. This sheers traffic away from the safety lane. In addition, each man has a flag. On a four-lane highway, I offset. The only other safe solution is to have the protection of law enforcement officers. The surveyor, in addition to protection of his men, also has the responsibility of not causing an accident.)
5. Indoctrination of men on safety.
   a. Be alert.
   b. Know your own job.
   c. Never step backwards.
   d. Be aware of traffic.
   e. Stay on centerline.
   f. Watch out for your fellow crewmen.
   g. Be ready to jump.
   h. Know the over-all picture of the particular job.
6. Wear colorful clothes, including loud shirt, red vest, and yellow cap. (I also use a red tripod with yellow streamers.)
7. Stay on the road a minimum time.
8. Stay off the roads when weather conditions are unfavorable.

The duties and responsibilities of the surveying profession then are threefold.

1. Instruct field crews in all safety procedures.
2. Work for the transfer of control points from the center of dangerous intersections and highways to sidewalks and shoulders.
3. Educate the motorist in safety, with stricter sentences for offenders.

This is not our fight alone, but is for the safety of anyone working in the street, pedestrians, cyclists, etc. As a public service, should we help carry the ball?

How about an exchange of ideas from surveyors in other parts of the country? What are you doing personally? Has your State any legislation along these lines? Should The American Congress on Surveying and Mapping have a Committee on Safety?

Satellite Methods in Geodesy

By JOHN A. O'KEEFE

U. S. ARMY MAP SERVICE

FOR THE PROBLEMS of precise surveying, there are two approaches. These two approaches have alternated with one another in relative importance, depending on the task involved and the available instruments, for many years.

The first approach is the direct one, through solid geometry, with its later offshoots, solid trigonometry and solid analytic geometry. It is a straightforward extension of the methods of plane geometry, plane trigonometry, and plane analytic geometry to three dimensions. Whatever complexities and difficulties it may have are due exclusively to the introduction of a third dimension.

We see this first approach being rapidly perfected today in the science of photogrammetry. Each day gives us neater and more economical methods for the solution of space resections, space intersections, stereograms, and the adjustments of strips and blocks of photography.

The other approach is somewhat more sophisticated. We begin by noticing the effects of atmospheric refraction. The atmosphere will bend a ray of light downward by as much as half a degree, or 1,800″, on a long line. The bending is not constant. There is a story, vouched for by one of the reconnaissance men in the business, of stations which are intervisible only at night. All day long an intermediate range of hills blocks the ray; but as night falls, the observer sees the distant range slowly loom up behind the nearer range.

Such phenomena as this tend to make one mistrustful of vertical angles. Satisfactory as they may be for construction problems or for mine surveys, the use of vertical angles over long distances is a risky business. Whenever possible, in ordinary surveying, the attempt is made to determine the amount of the refraction over the line by means of simultaneous reciprocal angles, observed at the two end stations, combined with measures of the temperature and pressure at the most favorable time of day. When reciprocal angles cannot be observed, the attainable accuracy is very unsatisfactory; the most familiar example is Mt. Everest, for which there are two accepted heights, differing by about 140 feet, or about 1 part in 200.

As a result of this fact, the geodesists learned to measure precise elevation without measuring vertical angles. The normal process of spirit leveling is an elaborate and ingenious attempt to avoid use of vertical angles, by making use of a telescope which is kept precisely level and of vertical rods for the measurements of height differences. Note, however, that these height differences are always measured from sea level; i.e., from a surface whose form is itself not known.

The situation is quite different with respect to horizontal angles. In first-order triangulation the mean correction to a horizontal direction is generally less than one second of arc. Hence horizontal angles can be used without any corrections for refraction to calculate new geodetic positions.

The coordinates of geodetic, horizontal control—geodetic latitudes, longitudes, and grid coordinates—are therefore built up from horizontal angles. They are really not points, but vertical lines; but they are symbolized, for convenience, as points on the geoid; and in the same way the coordinate differences are represented as distances on the geoid. Ultimately we come out with a complete net of angles and distances, including hundreds of thousands of points, all referred to a surface whose form we do not know.

When, for engineering reasons, or out

Presented at the 18th Annual Meeting of the American Congress on Surveying and Mapping, Washington, D. C., March 24–26, 1958.

of pure scientific curiosity, we decide to investigate the form of the surface, we do this by means either of astronomy or of gravity. By astronomy, we measure the slope of the geoid in space; and we build up the whole form of the geoid as a welder builds the frame of a ship, plate by plate. By gravity, we measure the total mass under each square foot of earth, and then we calculate how the sea level surface must slope everywhere so that it will everywhere set itself perpendicular to the net force of gravity. But these two methods of exploring the geoid are very little practiced; for example, we did not until last year possess a map showing the contour of the geoid even in the United States. The million-odd bench marks and station marks in the United States all refer to a surface whose form the average geodesist does not know and does not need to know. If you ask how high Pike's Peak is above the geoid you will find it is 14,110 feet, plus or minus not more than a foot; but if you ask how high it is above the center of the earth, you will be told that there is an uncertainty of hundreds of feet.

Let me repeat once more: the geodesy of today is ordinarily divided into five branches:

First, leveling, which measures height above the geoid.

Second, base measurement, which determines lengths on the geoid.

Third, triangulation, which, combined with base measurements, gives positions on the geoid.

Fourth and fifth, field astronomy and gravity, which find the shape of the geoid.

In a word, we creep about from point to point on the geoid, confined to a thin skin, from sea level to 10,000 feet elevation (about 1/2000 of the earth's whole radius), feeling out the form of the geoid like a blind man.

It is only with this background in mind that it is possible to perceive how revolutionary is the impact of the satellite methods of surveying. Under the heading of satellite methods, I am including the lunar methods; for the good old moon is still a satellite, though she is a big, rough, distant one.

Of the lunar methods, the easiest one to understand is the Markowitz moon-camera technique. This is, in theory, the last word in simplicity. The moon is simply photographed among the stars. By accurate measurements of various points of the limb, her position among the stars is found as seen from this spot. Now, if we draw the lines through the moon's center toward this point among the stars, and prolong it backwards, it will encounter the earth's surface at just one point, namely, the observer's position. By calculation, therefore, the observer can find out where he is.

But why the moon? you ask. Would not this be true for any celestial object? The answer is that it would, indeed. But as we get further and further from the earth, the points among the stars which correspond to the various points of the earth's surface get closer and closer together. At the distance of the moon, these points cover a circle with a radius of about one degree; at the distance of Mars, even at its closest approach, they cover less than one-half minute of arc. Hence, to find our place on earth via measurement on Mars would demand a precision of a second of arc to locate ourselves within 200 miles. At the sun's distance, 1″ means about 500 miles; at the distance of the nearest star, 1″ means about 75 million miles. Hence, we are pretty well tied down to the moon (at least at present); at the moon's distance, 1″ corresponds fairly closely to one nautical mile, when the moon is overhead. Note that I said 1″, not 1′ as in ordinary celestial navigation.

Now we see that, if we are going to get any good out of the Markowitz technique, these measurements must be precise to a fraction of a second of arc; for we can find our position within one nautical mile by the ordinary methods of celestial navigation. It is at this point that we begin to appreciate the formidable obstacles which were to be overcome to make a success of this technique. For example, the moon's own motion amounts to 1″ in 2 seconds of time. Since the fainter stars demand an exposure of several seconds, it is necessary to arrange to stop this motion optically; and this is done by the aid of a rotating prism. The

two exposures must be exactly simultaneous so that the effects of atmosphere and telescope vibrations will be exactly the same. And, of course, the timing must be nearly perfect.

An easier approach is offered by the use of eclipses. Here the harmful influences of the atmosphere are greatly reduced by the fact that the limb of the sun and that of the moon are aligned *in space*. Hence, we need only measure the time at which the last flash of light is seen before totality, or the first flash after totality. This is the method now being practiced by the U. S. Air Force, and formerly the Army Map Service.

This method, too, has its weaknesses. It is true that nothing that the atmosphere of the earth does can alter the geometrical pictures. But, alas, the atmosphere of the sun can and does blur the sharp cut-off. Instead of having a clear white surface, like a billiard ball, the sun has a fuzzy atmosphere, which dies out gradually with height. It is true that the thickness is a fraction of a second of arc; but this is quite enough to confuse the issue, in most cases which we have tried at the Army Map Service. Worst of all, the last little speck of the sun's edge twinkles like a star, so that it disappears, reappears, and disappears again. The twinkling is, in fact, worse than the twinkling of any ordinary star, because the air, whose currents are responsible for twinkling is more active by day than by night.

Another trouble is that the brightness level at which the sun's edge has its maximum sharpness is much lower than one might anticipate. This was one of the prime reasons why the 1948 eclipse failed to yield what had been hoped; namely, that I failed to choose the proper exposure times.

There is another way of measuring the moon's position among the stars, namely, by observing the instant at which a star's light is cut off by the moon's dark limb. This is like an eclipse; but it is called an occultation. Unlike an eclipse, an occultation is an almost instantaneous phenomenon; there isn't time for twinkling of the star to confuse the problem. The star's diameter is so tiny that there is no natural fuzziness in the problem to confuse the issue. Finally, there is no problem of determining the proper exposure level.

On the other hand, in the occultation problem we are working with just one single point of the moon's edge. Hence, it is necessary to make a calibration measurement of the moon's diameter at this same point on the same night. The observer who is to make the calibration measurement must be carefully placed so that the star will occult at the same point of the moon's edge, and this often results in putting him in some desert place, such as the Quinn River, in Nevada, or the edge of the Salton Sea, or the Carson Sink. On the whole, however, this method has yielded substantial results.

It is most important to see that, when we work with lunar methods, the whole distinction between horizontal and vertical angles is swept away. Refraction ceases to have any importance, because it is very nearly the same, if not exactly the same, for the moon as for the comparison star. Accordingly, the theorists who have dealt with these problems have abandoned the geoid as a reference surface. They have placed the origin of coordination at the center of the earth; and have built up systems of ordinary Cartesian rectangular coordinates. They have, one might say, cracked the sky. Each measure made applies just as much to the height of the geoid as to the horizontal coordinates.

It is, therefore, very fortunate that the lunar methods are just about to get a great lift from the introduction of the artificial satellite. These being almost a thousand times nearer than the moon; the same 1″ which represents one nautical mile at the moon's distance represents from 5 to 35 feet at the distance of the earth satellite.

Not all of this improvement can be exploited. Because of its faintness and its closeness, the United States satellite is a difficult object to observe optically. The timing must be exquisite, since a thousandth of a second will correspond to 25 feet. Nevertheless, there is no reason to doubt

that the satellite will set a new standard of precision in intercontinental distance measurements.

There are several experiments under way. First of all, Professor Whipple of Harvard College Observatory, one of the shrewdest of all observers, is building instruments fully capable of catching even this tiny object. Whipple has had a lot of experience in the observation of meteors, which are even fainter objects moving even faster. He is exploiting the satellite much as Markowitz has the moon.

The Naval Research Laboratory and the Army Map Service are tracking the satellite by means of the radio frequencies which it puts out. These are detected by large radio interferometers, which determine the space direction from which they come. Some of the radio telescopes are calibrated by measurements on the radio stars, so that the principles of operation are almost the same for the optical observations. Other radio telescopes are calibrated against airborne transmitters, which, in turn, are photographed against the stars.

All of these techniques applied to the satellite tend to give new and important data on the over-all size and shape of the earth. This is because the satellite is so close that the earth is the only perturbing body of any consequence. The period of the satellite in its orbit, combined with height determinations, will fix the earth's size; and the rate of change (precession) of the orbit plane will fix the earth's flattening.

The satellites provide us with a direct method of attacking the problem of intercontinental connections, since they are visible from both continents. Predictions of their paths made on the basis of information obtained in North America can be compared with observations in Europe. The discrepancies will reveal the systematic difference between the two continental triangulations. The satellites will thus pave the way for the unification of the triangulation of the whole world on a single datum.

Underlying the single single datum there must be a precise figure of the earth—that is, a precise measurement of the constants of the ellipsoid which best fits the sea level surface of the earth everywhere. This is the most ancient of all geodetic problems, the most famous, and the one on which the influence of the satellites will be the most decisive.

There are two constants required for the determination of an ellipsoid of revolution. These, in geodesy, are usually taken to be the semimajor axis of the generating ellipse, and its flattening. The flattening is specified numerically by giving the difference between the equatorial and the polar radii, in units of the equatorial radius.

It was pointed out some years ago by Lyman Spitzer that the satellite will yield an extraordinarily good determination of the earth's flattening. The method is one which has been widely used in astronomy to determine the flattenings of the planets. It depends on the fact that the plane of the orbit of a close satellite precesses, owing to the attraction of the earth's equatorial bulge. The same effect exists, of course, for the moon, but since the force involved decreases as the cube of the distance, the effects on the moon are much smaller. Moreover, in the case of the moon it is necessary to allow for a similar motion caused by the sun's attraction, which increases in proportion to the distance from the earth. (Naturally, the force exerted by the sun does not vary in any such way, but the *difference* between the force on the earth and that on the moon, which is what counts here, *does* vary in proportion to the distance from the earth.) Hence the precession of the satellite orbit will be much faster than the precession of the lunar orbit, and will be nearly uncontaminated by solar influences.

In fact, the motion of the satellite orbit will amount to about 400 miles per day. Since there is a difference of one part in 300 between what the Russians use for flattening of the earth and what the rest of the world uses, it is clear at once that, if the motion can be measured, we will have significant improvement in our knowledge. If we get accurate measurements over a period of a few weeks, the resulting determination should be of such precision as to put this problem out of the realm of practical geodetic needs.

The determination of the earth's size

offers more difficulty. The easiest way seems to be through Kepler's third law, which relates the size of the orbit to the period. If we could determine the constant of this law for the earth-centered system, then we could calculate precisely the period of an imaginary satellite skimming the earth at the equator. Since we know from gravity measures exactly what acceleration the imaginary satellite would suffer, we can calculate what the size of the orbit must be to bring the period and the acceleration into agreement. This would be the radius of the equator.

This method also can be applied to the moon. In fact, when Isaac Newton first proposed the law of gravity, he tested it by comparing the observed radius of the earth with the one calculated in this way. At first the results did not agree, and Newton then put the thing away. Later, Picard obtained an improved radius of the earth and Newton, one hearing of it, perceived that it was of the right size to produce agreement. He was so badly shaken up, however, that a friend had to complete the computations for him. Unfortunately, the method involves a small correction term depending on the mass of the moon, and this is not sufficiently well known to permit precise application of the method in our times.

If the satellite is at a height sufficient to suppress the effect of atmospheric drag, it can be expected that the chief source of irregularity in its motion will be the roughness of the earth's gravitational field. These are called anomalies if they are in the vertical direction, and deviations of the vertical if they are in the horizontal direction. For convenience here, let us call them all anomalies.

The root mean square value of the gravity anomalies at the surface of the earth is about 25 milligals, which means 0.25 mm/sec/sec. At the height of the satellite, there is a certain averaging effect, which considerably reduces this. In addition, the motion of the satellite itself is so rapid that it tends to average the effects of many anomalies. In consequence, the important quantity is the average value of the anomalies over rather large areas. According to Jeffreys (*The Earth*) the mean squared value over 30° squares is 150 (milligals)^2, which seems to mean root mean square values of 12 milligals. The satellite will traverse in about 480 seconds, and will thus receive an impulse which will change the velocity by about 50 mm/sec.

Acting alone, one such impulse would lead, after one day, to a change of position of about 5,000 meters, provided that it was in the direction along the path. If it were across the path, it would lead to periodic changes in position with a period equal to that of the satellite, and an amplitude of a few tens of meters. Since many such impulses occur in each revolution, and since there are about 16 revolutions per day, it is to be expected that the satellite will be several hundred meters off the path predicted on the basis of a smooth ellipsoid.

The distangling of this problem will therefore be of high interest not only to geodesists, but also to those whose job it is to furnish reasonably accurate ephemerides. The observations which will be most useful for this purpose will be, curiously enough, not the optical observations, despite their high precision, but the radio observations because of their great number, and above all, because their continuity will protect the theorist from attributing false periodicities to the perturbations which he will find.

In sum, therefore, the satellites can be expected to give us:

(1) A truly three-dimensional approach to the problem of large-area surveys;

(2) A new method of measuring intercontinental distances;

(3) A new method of measuring the figure of the earth; and

(4) A new approach to the large-scale irregularities of the earth's gravitational field.

Cartographic Classifications in the Civil Service

By C. MANSEL KEENE

CHIEF, STANDARDS DIVISION, U. S. CIVIL SERVICE COMMISSON

IT IS MY UNDERSTANDING that they put me on first so that this galaxy of stellar non-Sputnik attractions tonight will make up for any failure on the part of the Commission to carry through.

According to our statistics, there are about 7,387 individuals who are better prepared to talk on "How to Make a Living Making Maps" than I. You may feel that it is more than that, but I will grant that many.

We have about 2,700 people who are officially allocated to the cartography series, about 3,400 and some-odd in the cartographic aid series, and about 1,100 plus in cartographic drafting.

I assume that your greatest interest will be in what we are going to do about the tentative draft which you have seen for cartographers.

It will be released on November 25 in essentially the same shape as it came to you in the original draft. We have had only one serious set of criticisms. Unfortunately, they came from the agency which was the last to reply or we would have had a release on this particular series and this structure earlier.

One of the interesting problems we have been faced with, and which gave me at least some pause in meeting with you here tonight, was the fact that each of the separate agencies and bureaus within the agencies have asked us what we mean by our terms. We thought that, when we used certain terminology which we have found in existing positions, it was common to the profession but apparently it isn't, so, we may find ourselves using parenthetical definitions to be sure that all of us are meaning the same thing by what we say.

As you may know, we are, after many years of what I suppose we could call indecision confusion, identifying surveying as a field of engineering and as a professional field; we are saying that professional work in topographic and hydrographic surveying is to be identified in civil engineering, with a separate series for geodetic and cadastral surveying; we are saying that photogrammetry is an interdisciplinary area which can be filled, depending upon the emphasis placed on the job and on the qualifications of the individual needed to fill the job, by those trained in engineering, cartography, forestry, geology, or even in some cases in certain other professional areas.

What we are saying then, in effect, is, I am sure, something of which many of you have been aware for a long time; that there is a very close inter-relationship between the qualifications of the individuals and the jobs that they fill.

Some of you are notably aware of what those of us who specialize in classification have been saying for a long time, namely, that we classify jobs and not individuals.

I think that it is probably time we began to emphasize that the individual has a very important impact on his job and, in an area such as this, the coloration the job may take on as a result of the background and interests, program considerations to the contrary notwithstanding, of the individual filling the job.

We are attempting to do the same thing in this particular professional area that we have recently done in the area of engineering—establishing parallel professional and nonprofessional series, allowing an indi-

Presented at a combined meeting of the Cartography and Topography Divisions of the American Congress on Surveying and Mapping at Washington, D. C., November 6, 1957.

vidual to rise as high in the grade structure within either series as is commensurate with the range of duties and responsibilities of the job, without regard to whether he is professional or nonprofessional.

We are stressing to a continuing degree the interdependence of the qualifications of the individuals and the jobs they fill. I believe that we will, as time goes on, recognize more and more and try to build into the guidelines that we set up, rather flexible benchmarks to determine whether a job is in the professional field or in the technical support area.

We are going full speed ahead in the Commission's program in an attempt to get out standards. After six years in which we averaged 11 sets of standards a year, we had a backlog of 235 in June 1956. It is a little hard to imagine how we could work that off at the rate of 11 per year. We boosted production to 21 last year, and we hope to go over 50 this year. Among the standards, which we will be working on, will be some which are of more than a little interest to you. We will begin on the nonprofessional cartographic work shortly after the first of the coming calendar year, and from there we will undertake to develop standards for the professional cartographers and for cartographic drafting.

I would prefer now to reserve the rest of my remarks and try to evade your questions as you may ask them later.

* * *

Our "Books in Review" Department

In the January-March 1958 issue of SURVEYING AND MAPPING (pages 95–96) we ran a review of "Surveying" by Rayner and Schmidt, which was prepared by Draper K. Sutcliffe of Sutcliffe and Ward, Surveyors and Engineers, Baltimore and Bel Air, Md.

We have Mr. Sutcliffe's permission to publish the letter written to him under date of July 16, 1958, by ACSM President W. B. Williams. The text of the letter follows:

"Please accept my appreciation of a job well done in your review of 'Surveying' by Rayner and Schmidt in the January-March Quarterly. I missed it on first reading but caught it today and am placing an order for a copy of the book for our library.

"It would seem that if the Publications Committee could find others who have equal ability to express themselves clearly and a willingness to help, much of the reviewing might be allocated to practitioners. This should also be of distinct interest to publishers who have formerly depended to a large extent upon members of college faculties who may or may not have had extensive experience in practice."

This brings up a matter which has been worrying the editor for quite some time. We receive from time to time review copies of various texts on surveying and other books which could be of interest to the readers of SURVEYING AND MAPPING. However, we are quite often at a loss to know where to place the book for review. If members of ACSM who would be willing to review a book now and then would send in their names, we could build up a list of possible reviewers. This could be a definite help to the Publications Committee and the editorial staff, and should also make the "Books in Review" department of greater interest and value to our readers.

If any one of you "gentle readers" feel the urge to review a book please let us know. However, it is only fair to warn you that once you undertake to review a book the work should be completed promptly, because if the writing and publication of the review drags along for a long time the effectiveness of the review is lost.

It is a well known fact that one "gets out" of an organization in proportion as one "puts in." Do not hesitate, if you feel that you can be of help in any phase of the preparation and publication of our magazine, to let us know. "Many hands make light work" despite the notion that "too many cooks spoil the broth"—but we are not in the business of making soup. Speak up if you are willing to help.

—EDITOR

EDITOR'S NOTE.—Owing to a rather stupid oversight on the part of the editor of this Journal, the following summary of the *Comparison and Compilation of State Registration Requirements Concerned with the "Profession of Land Surveying,"* which should have followed the extensive tabulation, (SURVEYING AND MAPPING, July–September 1958, Vol. XVIII, No. 3, pages 294–303) was omitted. It is being published in this issue, as the best way out of a bad mess, and apologies are offered to our readers for the inconvenience that will be caused by this editorial carelessness. The summary which follows will appear in its proper place in the separates which are being printed, but there is nothing that can be done now to get it in its rightful place in SURVEYING AND MAPPING.

Summary

No estimate has been attempted regarding the number of persons who are allowed to practice surveying without a license. County surveyors (or similar State officials) and employees of highway departments are probably the most common examples of those who, without a license, do land surveying, record plats, and, in general, have the most contact with the public. Study of laws that control subdivision surveys and preparation of plats should reveal interesting data on the subject of surveying practitioners and surveying standards.

Most of those who are licensed, as shown in this summary, and are practicing Land Surveying are either "Professional Engineers" or "Professional Engineers and Land Surveyors." Of the 40 States that directly license Land Surveyors, only 19 specify that some Board members must have Land Surveyor licenses; only 13 specify that other Land Surveyors may give references for Land Surveyor applicants; only 5 States specify that the required references must be given by Land Surveyors; and only 11 States allow Land Surveyors to be on the Board unless they also have a Professional Engineer's license.

COMPOSITION OF EXAMINING OR LICENSING BOARDS

Examining Board		*Board Members*	
States	*Title*	*Professional Engineers*	*Land Surveyors*
3	Land Surveyors	2	10
22	Professional Engineers and Land Surveyors	101 (4)	15
15	Professional Engineers	77 (7)	
3	Professional Engineers (in Surveying and Mapping Fields)	16	

Numbers in parentheses indicate those P.E.s who must also be Land Surveyors.

In 1955, the National Council, State Boards of Engineering Examiners, listed 52 Boards with a total of 275 Engineer and Land Surveyor examiners, of which 32 showed that they held Professional Engineer and Land Surveyor licenses, and 6 show Land Surveyor licenses only.

In 1956 the registration lists showed 214,357 Professional Engineers. Of these, 11,519 are separately listed as Professional Engineers and Land Surveyors, and 11,357 as Land Surveyors. The lists do not indicate the complete extent of Land Surveyor practice, as many States allow Professional Engineers to practice Land Surveying without a separate Land Surveyor license. Also, it is not readily seen in some States whether or not a person holds both licenses; for example, in some States, separate listings are made in different sections of their rosters. Also there is a high percentage of duplication in the above totals, caused by so many persons who register in more than one State. For instance, in Virginia there are over 2,200 Registered Engineers, of whom over 900 reside out of the State; and there are also about 430 Land Surveyors, with about 70 residing outside the State.

DEFINITIONS

The 40 States or Territories that license Land Surveyors directly list the minimum

definitions in various wordings. Thirteen States list Land Surveying as a branch of engineering. Also, some States specifically mention various fields as parts of Land Surveying definitions, or as fields for licensing in Professional Engineering branches, as follows:

Field	*Number of States*
Topographic	21
Mining	7
Geodetic	6
Photogrammetry	2
Cadastral	3
Cartography	4
Geology	4
Landscape	31
Hydrography	2
Planning	5
Marine	1

Of those States that do not license Land Surveyors, 4 specifically exempt Land Surveying practice from Professional Engineer license requirements; other States specify that the Professional Engineer licensing act is not to interfere with other recognized professions.

Applicant Qualifications

In 2 and 3 below, college work of 3, 4, and 5 years is allowed, year for year, toward the experience required. Experience in all cases is of a nature satisfactory to the examining boards.

Land Surveyors

1. College graduate (4-year course) with 2 years experience. Examination is required by law in half of the States.
2. Average length of experience required is 6½ years. Examination is required.
3. Twelve years experience.

Professional Engineers

1. College graduate (4-year course) with an average of 3½ years experience. Examination is required by law in half of the States.
2. Average length of experience required is 8½ years. Examination is required.
3. Average length of experience required is 13½ years.

Examinations

Many boards omitted completing this item and there are insufficient data for complete analysis at this time.

References

The average requirement is for 5 references, one of whom must be a Land Surveyor, and two or more must be Professional Engineers.

Details include:

Not specified	6	States
Land Surveyors specified	4	"
Land Surveyors or Professional Engineers specified.	14	"
Professional Engineers specified.	19	"

Ethics

Of the 52 States or Territories, 21 require or ask adherence to a Code of Ethics. This is in addition to usual clauses for revocation of license.

Professional Engineering Branches

In 14 States and in Puerto Rico, Professional Engineering only is listed. In 36 States or Territories the average number of Branches listed is 20.

Reciprocity

Reciprocity generally is available, but is at the complete discretion of the individual State Boards. Generally, a person is not eligible for reciprocity unless he has at least passed a written examination in some other State.

Exemptions or Exceptions

In many States, interpractice in the fields of Professional Engineering, Land Surveying, and Architecture is specifically mentioned.

Interpractice

Professional Engineers may practice Land Surveying in 9 States.

Civil Engineers may practice Land Surveying in 2 States.

Architects may do Engineering work incidental to their practice in 13 States.

Engineers may do Architectural work incidental to their practice in 7 States.

Architects may do Land Surveying incidental to their practice in 3 States.

Professional Engineers may do Land Surveying incidental to their practice in 3 States.

Land Surveying is exempt from Professional Engineering practice in 4 States and, by inference, in 3 States.

Land Surveyors are the only persons who may record plats in 9 States.

Model 4 Geodimeter

The wraps have now been taken off the long-awaited Model 4 Geodimeter. This short-range model was exhibited at the American Mining Congress, San Francisco, Calif., September 22–25, 1958; at the Western Regional Conference of the American Congress on Surveying and Mapping, Monterey, Calif., October 9–11, 1958; and at the meeting of the American Society of Professional Engineers, New York, October 13–17, 1958. It is presumed that it will be on display at the Washington meeting of the American Congress on Surveying and Mapping in March, 1959.

Designed for use on lines up to three miles in length and, according to the manufacturer, capable of being used on lines less than 100 feet in length, this new model should bring electronic distance measurement within the realm of "ordinary surveying" as distinguished from geodetic surveying, to which the earlier models of the Geodimeter were adapted.

Visit A.C.S.M. National Headquarters

When sojourning in the Nation's Capitol don't fail to visit the new national headquarters located in the heart of Washington on the 9th Floor of the Washington Building, 15th and New York Avenue, N.W.

Congenial men like Capt. H. W. Hemple, Ret., Capt. F. S. Borden, Ret., Maj. R. T. Evans, Ret., and last but not least Mr. Walter Dix, will greet you with a warm and hearty welcome. Not only can these men direct your efforts to help you get information that you may want, but you can examine current scientific and engineering magazines, journals, and periodicals. These publications come from all corners of the earth on an exchange basis with the quarterly journal SURVEYING AND MAPPING. To mention a few of the many publications available there are the *Empire Survey Review, The New Zealand Surveyor,* the *Bulletin Géodésique, The Australian Surveyor, The Canadian Surveyor,* etc. Publications in German and French are also available.

A few hours spent in these pleasant surroundings can prove very profitable. When in Washington make it a point to visit the national headquarters of A.C.S.M.

Timesavers in Computing

By MAURICE GOULD*

THIS ARTICLE is being published to stimulate interest in developing timesaving solutions as applied specifically to computations for subdivisions. It is surprising to know that many surveyors still solve problems by methods that were adapted to the use of logarithms. Due to the coming-of-age of the modern electric calculator, some of these methods have become as old-fashioned as the horse and buggy of yesteryear.

This is more apparent in computations for subdivisions, where there is a growing demand for curvilinear streets and where Planning Boards are imposing greater restrictions. It is quite evident that, because of these growing demands, computing becomes more specialized, and computations can be so involved and intricate that the horse-and-buggy methods are quite laborious. Hence, any discussion of new methods which promises to save time should be of great value to the surveyor.

The following solution is one of many timesaving methods I have developed.

THE PROBLEM

When $M \cos x + N \sin x = P$, to solve for the angle "x" when M, N, and P are given dimensions.

In this problem the standard solution is to substitute for $\cos^2 x$ its identity $(1 - \sin^2 x)$ and we finally end up with the quadratic

$$(M^2 + N^2) \sin^2 x - 2NP \sin x + (P^2 - M^2) = 0$$

Since the constants are squared, the numbers become immense. As a result, the solution is laborious, with a great probability of introducing errors.

THE SOLUTION

As an alternative, this same problem can be solved more easily and in less time with the aid of an auxiliary right triangle whose

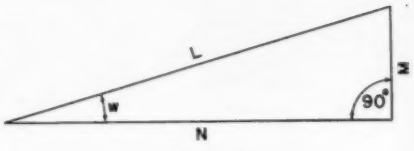

FIGURE 1.

legs are the given constants M and N, as shown: (Figure 1)

$$M = L \sin w$$
$$N = L \cos w$$

Substituting in the original equation, $M \cos x + N \sin x = P$ becomes

$$L \sin w \cos x + L \cos w \sin x = P$$
$$L(\sin w \cos x + \cos w \sin x) = P$$

Finally, $\sin (x + w) = P/L$ gives two answers, depending on the sign of P/L.

The angle x is finally determined by subtracting from $(x + w)$ the angle w, where

$$w = \tan^{-1} (M/N)$$

The standard solution takes 25 minutes, while the second is solved in 12 minutes. In addition to the saving in time, the probability of error is greatly reduced.

It has been my experience that, whenever I come up with a quadratic, I can find an equation in the form

$$M \cos x + N \sin x = P$$

I find that this formula pays off well in time dividends, especially in problems of a difficult nature. For example, take the problem which was submitted by Henry L. Thompson in his paper "Application of the Method of Double Position to Surveying Problems."†

To find the radius of a circle tangent to the line AB and to two other circles,
Given: (Figure 2)

$E = 80.00$ = radius of the first circle
$C = 50.00$ = distance from its center to AB

* Licensed Land Surveyor (N.Y.) and formerly Assistant Civil Engineer, Topographical Bureau, Borough of Queens, N.Y.C.

† *See* SURVEYING AND MAPPING, October–December 1954, Vol. XIV, No. 4, pages 466–469.

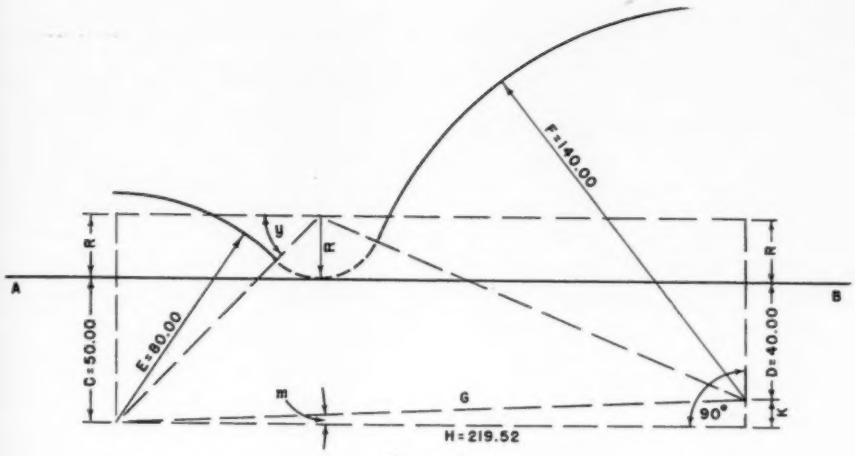

FIGURE 2.

$F = 140.00$ = radius of the second circle
$D = 40.00$ = distance from its center to AB
$H = 219.52$ = the projection of the line between the centers of the circles to the line AB.

I am taking the liberty of using the same data for a check on the answer. The final equations becomes:

$$M \sin y + N \cos y = P$$

with

$$M = \frac{[G + (F - E)] \times [G - (F - E)]}{(E - C)} + 2K$$

$$N = 2H$$

$$P = \frac{[G - (F - C)] \times [G + (F - C)]}{(E - C)} + (E - C)$$

NOTE: The reason for using fractions, as shown, is that each fraction represents a linear dimension, thereby ending the decimal within the accuracy of the problem. It is advisable to carry the fraction one additional decimal past the final figures to be used.

$$K = (C - D) = 50.00 - 40.00 = 10.00$$

$$\tan m = 10.00 \div 219.52 = 0.0455539$$

$$m = 2° 36' 30''$$

$$G = \frac{219.52}{\cos 2° 36' 30''} = 219.748$$

$$(0.9989640)$$

$$E - C = 80.00 - 50.00 = 30.00$$

$$F - C = 140.00 - 80.00 = 60.00$$

$$\frac{[G + (F - E)] \times [G - (F - E)]}{(E - C)} =$$

$$\frac{(279.748) \qquad (159.748)}{(219.748 + 60.000) \times (219.748 - 60.000)}{30.00} =$$

$$1489.639$$

$$+ 20.000 = 2K$$

$$1509.639 = M$$

$$2H = 2 \times 219.52 = 439.040 = N$$

$$(F - C) = 140.00 - 50.00 = 90.00$$

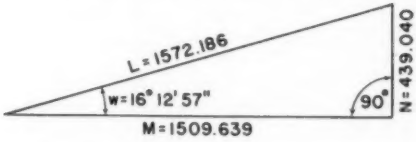

FIGURE 3.

$$\frac{[G - (F - C)] \times [G + (F - C)]}{(E - C)} =$$

$$\frac{(129.748) \qquad (309.748)}{(219.748 - 90.00) \times (219.748 + 90.00)}{30.00} =$$

$$1339.639$$

$$+ 30.000 = E - C$$

$$1369.639 = P$$

$$M \sin y + N \cos y = P$$

$$\tan w = \frac{439.040}{1509.639} = 0.2908245 = \tan 16° 12' 57''$$

$$L = \frac{1509.639}{0.96021655} = 1572.186$$

$N = L \sin w$, and $M = L \cos w$

$$L(\sin y \cos w + \cos y \sin w) = P$$

$$P/L = \sin(w+y) = \frac{1369.639}{1572.168} = 0.8711686$$

$$w+y = 60^\circ\ 35'\ 41'' \qquad 119^\circ\ 24'\ 19''$$
$$w = 16^\circ\ 12'\ 57'' \qquad 16^\circ\ 12'\ 57''$$
$$y = \overline{44^\circ\ 22'\ 44''} \qquad \overline{103^\circ\ 11'\ 22''}$$
(Hold) (Reject)

$$R = \frac{E \sin y - C}{1 - \sin y} =$$

$$\frac{80\ (0.6993862) - 50.00}{0.3006138} =$$

19.80 (Check)

The time required to solve this problem by the method shown was twenty minutes.

This solution comes in handy for more involved problems, such as:

(1) Circle tangent to three circles.

(2) Circle tangent to two circles and passing through one point.

(3) Circle tangent to one circle and passing through two points.

(4) Circle tangent to a line, tangent to one circle, and passing through a point, etc.

I would be glad to send the derivation of the above solution to anyone upon request. Address: Maurice Gould, 147-15 69th Road, Flushing 67, N. Y.

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New Geographic Center of the United States

The new position of the geographic center of the United States including Alaska, which was announced July 30, 1958 by the Director of the Coast and Geodetic Survey, is approximately 439 miles in a northwesterly direction from its previous location near Lebanon, Kansas.

The new center, located approximately at latitude 44° 59′ North and longitude 103° 38′ West, in Butte County, South Dakota, was computed by Survey mathematicians in response to public interest since the approval on July 7, 1958, of an act to provide for the admission of the State of Alaska into the Union.

Although now unmarked the geographic center is about 11 miles west of Castle Rock, S. D., and 20 miles east of the tri-State corner of South Dakota, Montana, and Wyoming. It is near a hill which bears the descriptive name of Two Top Peak.

Due to the difficulty of determining the exact geographic center of two large, irregular, and separated areas on a spheroid, the uncertainty of the new location may be set at about 10 miles in any direction.

Several methods of approaching the solution are available, but none are of any scientific significance. The one employed in this instance is probably best termed the center-of-gravity method. If one imagines a weightless spherical shell on which the areas of only the United States and Alaska are painted with an absolute uniform thickness, then the center of gravity, or the geographic center, might be said to be that point at which the shell will balance. This is the general concept that was approximated, although no great degree of precision is claimed.

In computing the new position the mathematicians started with the geographic center of the 48 States near Lebanon, Kansas, which had been computed by the Coast and Geodetic Survey about 40 years ago, to be approximately at latitude 39° 50′ North and longitude 98° 35′ West. In the next step they determined the geographic center of Alaska using a method similar to the center-of-gravity method.

In the computations, water areas were excluded with exception of inland waters and straits, passes, canals, etc., in the Alexander Archipelago in southeast Alaska. The geographic center of Alaska including offlying islands, such as the Aleutians and those in the Bering Sea was determined to be approximately at latitude 63° 50′ North and longitude 152° 00′ West. The uncertainty of this location, about 60 miles northwest of Mt. McKinley, is set at about 15 to 20 miles in any direction.

In the final determination of the geographic center, the 3,022,400 square mile area of the 48 contiguous States was weighed against the 586,400 square miles of Alaska. The new location is considered to be at that point along a line of shortest distance between the two centers where the areas would balance.

The Status of Surveying and Mapping in the United States

Final Report by the Task Committee on Status of Surveying

SURVEYING AND MAPPING DIVISION
AMERICAN SOCIETY OF CIVIL ENGINEERS

Brother B. Austin Barry is scheduled to present the latest information concerning the activities of the Task Committee on Status of Surveying and Mapping, Surveying and Mapping Division, American Society of Civil Engineers, at the 19th Annual Meeting of the American Congress on Surveying and Mapping, Washington, D. C., March 11–13, 1959.

SURVEYING AND MAPPING has published the two previous Interim Reports* of that committee and now presents, in the following pages, the Final Report. This Final Report is published in order that persons attending the 19th Annual Meeting of ACSM will be better informed on the subject and better prepared to discuss it.

At the time the following material was prepared for publication in this Journal, this Final Report had been presented to and approved by the Executive Committee of the Surveying and Mapping Division, but it had not yet been approved by the American Society of Civil Engineers. Therefore, this Final Report as published here is not to be considered as representing the policies of that organization. —EDITOR

*See SURVEYING AND MAPPING, April–June 1957, Vol. XVII, No. 2, pages 203–205, and SURVEYING AND MAPPING, October–December 1957, Vol. XVII, No. 4 (Supplement).

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2nd Annual Conference of Illinois Land Surveyors Planned

The surveyors of Illinois will meet on the University of Illinois campus, February 5, 6, and 7, 1959, for their second annual conference. Many interesting topics are included on the program such as Rights of Way and the Plat Act, Land Planning and the Surveyor, Standards for Highway Surveys, Monumentation, Original Records, Electronic Computers, State Plane Coordinates, Photogrammetry, and others.

The attendance is expected to reach 150 persons this year, slightly more than the 114 in 1958. The three-day affair will be highlighted by a banquet at the Urbana-Lincoln Hotel. A ladies program is planned.

Illinois Conference Proceedings Available

The complete proceedings of the 1958 Illinois Land Surveyors Conference are now available from the Division of University Extension, University of Illinois, Urbana, Illinois.

All papers, panels, and discussions are included in this volume. Anyone may obtain a copy for $5 from the Extension Division.

THE STATUS OF SURVEYING AND MAPPING IN THE UNITED STATES

Final Report by the Task Committee on Status of Surveying and Mapping, Surveying and Mapping Division, American Society of Civil Engineers

October 14, 1958

Endorsed by Executive Committee of Surveying & Mapping Division as Amended: October 15, 1958

A - General Background of the Problem

In the past decade, certain problems relating to the professional status of its surveying-mapping members prompted the American Society of Civil Engineers in 1954 to inaugurate a study of surveying and mapping activities in the United States. A Task Committee on Status of Surveying and Mapping was appointed to report on two questions:

a. Which parts or activities of surveying and mapping are professional, and which are not?
b. Which parts or activities of surveying and mapping are engineering, and which are not?

These two questions have been under close scrutiny now for nearly four years, and herein are presented the results of various phases of the study.

Ethical Considerations

The problems that prompted the action mentioned above were typically these:

a. Certain federal surveying-mapping agencies (e.g., Corps Corps of Engineers) and state and municipal bodies were seeking to contract for the hire of surveying personnel on a competitive-price basis, a practice that many ASCE members reported as violating the ASCE code of ethics;
b. Contracts for preparation of topographic maps by use of photogrammetry were frequently awarded to corporations on a competetive-price basis, again suggested as a violation of ethics.

Other problems of a minor nature and similar thereto, not the least being the recurrent question of admitting land (property) surveyors to engineering license or to engineering societies, added weight in favor of the study.

Committee Personnel

The Task Committee is composed of three members: representing federal mapping agencies, Mr. George D. Whitmore, Chief Topographic Engineer of the U. S. Geological Survey, Washington; representing private practice (or industry), Mr. Alfred O. Quinn, Chief Engineer of Aero Service Corporation, Philadelphia; and representing engineering education, Brother B. Austin Barry, Associate Professor of Civil Engineering at Manhattan College, New York, as Chairman.

B - First Report (1955): What in Surveying is Professional

At the start, it was found necessary to ascertain a good definition of the term professional. In its first report* the Task Committee cited four distinguished authorities and noted that, among other attributes, these are primarily the distinguishing marks of a profession (or of professional work):

a. It is of a high intellectual nature;
b. It must require the exercise of judgment and is not subject to standardization;
c. It must satisfy an important social need;
d. It has a body of advanced knowledge (science) and an art (skill) not commonly possessed by the general public.
e. Its practitioners are usually prepared on the college or university level in a specialized intellectual technique (as well as in general areas of learning);
f. Its members must have a motive of service, assume relations of confidence, and accept individual responsibility;
g. There must be some social recognition and regulation of the profession.

* First report: "Professional Aspects of Surveying and Mapping" dated October 24, 1955; published as Paper #921, Journal of Surveying and Mapping Division of ASCE, Vol. 82, No. SU1, March 1956.

On the basis of these characteristics, all categories of surveying-mapping activity were studied and the individual job classifications were designated as professional-level, technician-level, or pre-professional-level in nature. Definitions were also included for each professional title in the attached classification chart (Appendix D). In each case, the professional person is distinguished from the technician, who usually works under the direction of a professional.

Professional vs. Technician

The tenets used for the differentiation throughout the study are as follows:

> Professional Level: Work that involves the exercise of professional judgment, frequently based on knowledge acquired through higher learning, generally non-routine in character. The term implies one who can plan, perform, and/or direct all such operations in the category; this person is responsible for work performed by those under him.
>
> Technician Level: Work that is primarily routine, of a technical nature, often demanding a higher degree of skill, done under the direction of a professional person who is responsible for its outcome. Such work is preprofessional when [redacted] performed by a professional trainee who, having completed courses of specialized intellectual instruction and study, is seeking to attain professional status.

It might be appropriate to state that such a differentiation between professional and technician had not previously been made, but that its acceptance upon publication was unanimous, indicating that such is a very natural pattern of human behavior. Similarly, while no comprehensive classification of surveying-mapping activities had ever been published, the six categories shown met with general approval as well. The Task Committee submits this Classification Chart as part of its present final report. (See Appendix D.)

C - Interim Report (1956): What in Surveying is Engineering *

Having completed the initial phase of the study, it became necessary to determine which of the six categories of activity are properly engineering activity. In October 1956, the Task Committee (Interim Report) listed its findings, as follows:

1. Land or Property Surveying (Cadastral) was stated to be separate and distinct from engineering, as determined from the official pronouncements of two groups:
   a. In 1948, the statement of the National Council of State Boards of Engineering Examiners (NCSBEE). (See Appendix A.)
   b. In 1952, the resolution of the National Society of Professional Engineers (NSPE). (See Appendix B.)
2. Engineering Surveys (for Design and Construction), because widely recognized as engineering, were identified as engineering;
3. Geodetic Surveying, Geodetic Engineering, or Geodesy was listed as engineering work in nearly its entire scope;
4. Cartographic Surveying, Cartographic Engineering,

* "Interim Report of the Task Committee on Status of Surveying and Mapping" of October 18, 1956, published in Civil Engineering of March 1957.

or Map and Chart Surveying was called engineering because so determined by the NCSBEE, the NSPE, and by a 1952 statement of the ASCE Board of Direction, as also because so adjudged generally by various state boards of engineering registration. (See Appendices A, B, and C.)

5. Aerial Survey Services (adjunct services not necessarily linked to photogrammetric mapping) were listed as non-engineering;

6. Cartography (map compilation from other than original surveys, map finishing, map reproduction) was listed as non-engineering.

Reaction of the Profession

Efforts to publicize these findings widely resulted in many responses from all parts of the United States. The land surveying statement caused by far the greatest discussion, with many groups and individuals strongly endorsing the stated view and with just as many others objecting thereto with equal vigor. Many analyses were made by land surveying groups, state and regional, but no general agreement was found to exist among them.

At this point, the American Congress on Surveying and Mapping (ACSM) became greatly interested and attempted to act as spokesman for land surveyors throughout the nation. At the suggestion of ACSM, Mr. Victor H. Ghent, land surveyor from Virginia, became an associate member of the Task Committee to act as ACSM liaison and to offer counsel in the deliberations. Mr. Ghent's aid is hereby gratefully acknowledged.

D - Second Interim Report (1957): Modification re Land Surveying

With a fairly unified opinion across the country concerning the categories II through VI, but with a general lack of accord on category I, Land or Property Surveying (Cadastral), the report of October 1957 (Second Interim Report) of the Task Committee * was a restatement of its October 1956 findings, with a single exception. The change, concerning category I, was this statement:

> We find that more than half of the profession (including a national committee of surveying teachers) believe that Category I (Land Surveying-Cadastral) should continue to be regarded as a branch of civil engineering... We must therefore retract the recommendation of 1956 that land surveying be regarded as an activity separate and distinct from engineering.

With an unsettled question of such magnitude facing it, the Task Committee immediately presented (in form of an Appendix attached to the Second Interim Report) a partially developed thesis that would "retain" land surveying as a part of engineering. There began simultaneously a severe scrutiny by the Task Committee of all the reasons for retaining any part of surveying within the domain of engineering, especially for retaining land (property) surveying. The present report is the result of this scrutiny.

E - Findings of the Present Report

Primary and basic attention was given to the fundamental question, "Does the practice of Surveying and Mapping as defined and categorized by the Committee constitute the practice of Professional Engineering?" Two facets of the problem were seen to be important: (I) recognition by the engineering profession, and (II) recognition by the legally constituted bodies, i.e., the various state laws and boards of professional licensing.

A review of the registration laws for professional engineers in the country indicates that a uniform and clear-cut decision has not been made. Some states, such as Pennsylvania, specifically include surveying (and mapping) as a part of the basic definitions of professional engineering practice; others have no reference to surveying-mapping in their laws; and in still other states, opinions by Attorney Generals have excluded all or parts of the Surveying profession from engineering and the requirement for licensing.

Since a lack of uniformity of state laws and rulings exists, the Task Committee felt that the basic definition and resolution of the professional status of surveying and mapping should emanate from the engineering profession itself. When the engineers have placed surveying and mapping in its proper professional position, a positive statement can be made to the licensing boards to attain legal recognition.

As a result of thorough deliberation and widespread consultation during the past year, the Task Committee feels that it is ready to present in this final report, certain findings on matters not covered in the prior interim reports. The findings are followed by a series of conclusions, and concomitant recommendations. The recommendations collectively constitute, in effect, a policy position for ASCE as principal spokesman for the civil engineering profession, as well as a program of action for state registration boards, engineering schools, ASCE's Surveying and Mapping Division, other professional societies, and individual engineers and surveyors throughout the country.

Basic Considerations

From a fundamental point of view, the practice of engineering includes the use and recognition of the properties of matter and the sources of power in nature to provide tools, structures, machines, and conveniences useful to man. This broad scope of activity demands the professional services of persons schooled and skilled in the basic laws of nature and materials to successfully apply engineering principles. The Committee concludes that the application of the engineering concepts of mathematics, astronomy, mechanics, physics, and human management as practiced by persons engaged in activities defined in categories I, II, III, and IV of this report constitutes the practice of professional engineering. The investigation, planning, design, and responsible supervision of surveying operations, the construction of surveying equipment and/or systems, and the location, delimitation, and delineation of natural and physical features on the surface of the earth fulfill the requirements for engineering practice. The exercise of these responsibilities does require higher and professional education which the Committee believes must be satisfied by the completion of an engineering curriculum in a college or school having adequate equipment, resources, and professional instructors to provide at least a four-year program.

Re Land Surveying

The place in engineering of our category I, Land Surveying (Property, Cadastral), is the subject of greatest controversy throughout the country and of greatest concern to this committee. The principal facts relevant to the matter seem to be:

1. A substantial majority of the civil engineering profession throughout the United States firmly believe categories II, III, and IV to be engineering.

2. However, with regard to category I, probably a majority of the profession feel that property surveying should be considered engineering and be "retained" within the branch of civil engineering. Many others believe that this category of work, while admittedly fully professional in nature, should be splintered off from engineering and be allowed to form into a separate professional group.

3. Probably a majority of private-practice property surveyors are also licensed (registered) as professional engineers, which seems to work out very well in practice, as both capabilities are required on many projects and, in any case, they tend to be complementary activities.

4. Others in private practice not so dually licensed usually find it necessary, in order to stay in business, to combine property surveying with certain auxiliary jobs that are generally considered to be engineering, e.g., subdivision development and construction layout.

The Task Committee believes, so far as the surveying

* "Second Interim Report of the Task Committee on Status of Surveying and Mapping" of October 18, 1957, not published but rather widely distributed by the Task Committee.

and measurement sciences are concerned, that property surveying in the future will necessarily become increasingly more precise and complex, and will necessarily utilize geodetic, photogrammetric, electronic, and other advanced procedures. The Committee feels that the measurements made to ascertain the size and shape of the earth, as well as those to ascertain a distance between two points three hundred feet apart, are part of the same science. Similarly, surveying for the topographic plan for a 2-acre plot is part of the same science as mapping an entire State, although the specific techniques be different.

The Task Committee therefore advocates that the practice of property surveying, (usually referred to as land surveying in state registration acts), be considered to be an integral part of the surveying and mapping complex, and consequently of engineering. As a corollary, the Task Committee also advocates that a basic engineering education, preferably with some emphasis in the surveying and mapping sciences, should be prerequisite for all land surveyors of the future, as it should be also prerequisite for those who specialize in any other categories of surveying and mapping.

While admitting that property surveying and survey engineering are thus basically akin, identified in fact, the Task Committee here points out an additional important requirement for an engineer engaged in property surveying: a knowledge of property law and of local conditions. As has been established, all who wish to practice property surveying should be basically engineers (and should be equipped with the B. C. E degree or equivalent) because of the similarity of the knowledge and tools needed for both, and there should be no need for a separate L.S. examination and registration law.

It is most important, however, for all to recognize the peculiar nature of property surveying, which demands a specialized knowledge of property law and of local conditions. Because of the particular conditions that exist in many states in regard to land surveyors, platting laws, recording laws, etc., it is felt that each state must work out for itself the most practical methods of transition from land surveyor and professional engineer licenses to the single professional engineer license.

We envision that in the future it will be imperative that engineers be very careful, therefore, in judging their own competency to practice property surveying. This will require a renewed sense of ethics within the profession, but we are strong in the belief that without such a proper ethical basis a profession cannot exist.

Re Photogrammetry

In view of the past controversies regarding the place of photogrammetry in topographic surveying and mapping, and in engineering, it is felt desirable to repeat here in some detail the views of the Task Committee on this matter.

It is the Committee's judgment that the use of photogrammetry involved in making a topographic plan or map, for example, is engineering work. However, certain adjunct aerial survey services (e.g., obtaining aerial photographs,etc.) in themselves are regarded as non-engineering. The findings of the Task Committee regarding photogrammetric activity are simply stated in the Interim Report: "The photogrammetric methods of Categories I, II, III, and IV are engineering procedures by reason of their being operations of an engineering project, e.g., the preparation of a topographic map."

Certain difficulties seem to surround this concept of photogrammetry as a procedure, for some persons would have the method divorced from engineering and become a profession by itself.

It is the view of this Committee that the topographic plan or map, aside from its inherent value as an engineering instrument when completed, is itself a project that is engineered in its construction. The basic elements of lineal and angular measurements, and the selection of the proper instruments and procedures for each of the succession of operations beginning with horizontal and vertical control, must be commensurate with the purposes of the product. As the concept of measurement evaluation is essentially the basis of engineering, we hold that the topographic plan or map, whether or not produced mainly by means of photogrammetric surveying (or any other surveying method yet to be devised) rather than traditional ground surveys, is an engineered accomplishment.

Furthermore, it should be noted that a topographic plan or map is an engineering instrument, a basis on which engineering design is to be based, and that production of such topographic plan or map is undertaken for the value it will have for engineering planning and design for such as highways, dams, reservoirs, irrigation systems, drainage systems, industrial sites, subdivisions, etc. Vast sums of design and construction money will be expended on the basis of the map's information. Only in the measure that the plan is reliable can it be of any use, and it is manifestly impossible for the user to check the entire map for reliability without inordinate expenditure of time and effort. The reliability therefore is something that must be worked into the map by professionally accepted methods, competent and informed personnel, precision equipment, and (primarily) engineering planning and supervision at every stage of the process. It would be unwise to entrust the basic mapping of terrain and culture at any useful engineering scale to persons lacking a sense of plotting accuracy and of the implications of map error (and blunder).

It is well to remember that the use of aerial photographs in the surveying and mapping field has brought about the development of the science of photogrammetry. The original service offered by private practitioners was almost exclusively that of taking aerial photographs (classified as non-engineering) and it became common practice to obtain this service through competitive bidding. Later, when photogrammetric survey operations were added, competitive bidding was continued even when highly accurate, detailed surveys,and topographic plans and maps were a major part of the contract. The continuance of the competitive bidding practice also can be attributed to the relative newness of the photogrammetric methods (though European countries have utilized the basic principles for many decades), and the consequent reluctance of the public and of public bodies to risk money on untried procedures. The Committee is confident that persons who specialize in photogrammetric surveying procedures will welcome a clarification of their status and the recognition of their work as professional engineering, and that this should ultimately eliminate the practice of competitive bidding from this activity.

Re New Umbrella Term

The Task Committee believes that Categories II, III, and IV clearly form the content of the "earth-measuring" sciences. We find, further, that Category I, Land Surveying (cadastral) falls into this concept and, as recommended herein, should henceforth demand that its practitioners be engineers with specialized additional training and background. Thus we find that this field may well include geodesy, topography, hydrography, photogrammetry, engineering and construction surveying, property surveying, and the like.

Heretofore much reliance has been placed on the term "surveying and mapping" as an overall designation, although the term "cartography" was also used for a few years by Government agencies under instructions of the U. S. Civil Service Commission. We find that "surveying and mapping" as a designation is not only cumbersome, but falls short of conveying the proper meaning. The term "cartography" never found full acceptance among surveying-mapping practitioners in the United States.

The Task Committee therefore has attempted to find an appropriate name for the entire content of these "earth-measuring" sciences, a term which would serve to denote the entire field of Categories I, II, III, and IV. To date no agreement has been reached on a new umbrella term but the most appropriate names seem to be these three:

1. Survey Engineering, as proposed in an early report, meets with favor by many.
2. Geodetic Engineering, is the name acceptable to many others, although its basic weakness as a designation for the entire field stems from its being already the designation of one of the parts of the whole. European practice might be pointed to as a precedent for its use, however.
3. Geometronic Engineering, a term coined by Walter S. Dix, A.M., Am. Soc. C. E., and Secretary of A.C.S.M., meets with considerable favor by many persons although it is so new and untried that its use in this sense must be regarded as highly tentative.

The Task Committee offers these three terms for con-

sideration without advocating any, recommending, however, that an umbrella designation is needed and should be used in referring to the work of the first four categories. Throughout the remainder of this report the term survey engineering is generally used, though such use is intended to be without prejudice to either of the other terms or to any other acceptable designation.

Re Education

In the deeper study of surveying and mapping during the past year, two significant and pertinent trends have become apparent to the Task Committee:

1. Engineering as a profession is beginning, more than ever since its inception 150 years ago, to emerge clearly as a scientifically-oriented profession. No longer is it based primarily upon the art (the how-to-do), but is now assuredly founded on the principles of science. Educational institutions are rightly showing the way in this emergence of the new concept of engineering.
2. Surveying, concurrently, may be losing its place in the civil engineering curriculum, probably because:
   a) in the past elementary surveying has been taught mainly as an art, or how-to-do course, the type of course now being eliminated in many schools; and
   b) unfortunately there is now not sufficient time available in a 4-year degree program to include the variety of subjects currently required in advanced surveying and mapping courses.

We find that educational facilities for geodetic surveying (Category III) and cartographic (topographic and hydrographic) surveying-mapping (Category IV), though recognized widely as being engineering, have been neglected in the United States to a serious degree. There are only a few engineering schools where the work is taught in the undergraduate curriculum despite today's drastic need for scientific manpower in these two fields specifically. Since the educational facilities for housing the body of professional knowledge are essential to making a profession, we believe that in this instance the lack of sufficient courses in surveying-mapping subjects is a serious impairment of the profession.

Perhaps worse off from the educational standpoint is property surveying, for preparation therefor is not generally regarded as an obligation of the colleges and universities. The legal aspects of property surveying are of the greatest importance, and surely warrant at the least an elective course in a few schools.

We take this occasion to sound a warning that we may soon be caught up in a shortage of intellectually competent persons able to carry on the necessary, even vital, function of geodesy, photogrammetry, topography-hydrography, and cadastral surveying on a professional level.

We believe that the present usual method of studying these important sciences, mainly self study while on in-service training assignments, will only result in shrinking the body of knowledge, in losing potentially high-caliber persons in the field, in stifling research in a vital science, and in lowering the stature of a professional field.

Sepcifically, where should such a body of knowledge be housed? Although a few persons would prefer to see the field of surveying and mapping splintered from engineering and be given a fresh start in the colleges of arts and sciences, it seems clear that a large majority of the civil engineering profession would much prefer that the engineering schools continue to be identified with all of the surveying and mapping sciences, on the grounds that in content and method they are most nearly engineering (as opposed to being simple or basic science). Some educators have included the geodetic sciences among the recognized engineering sciences.

The Task Committee believes that the engineering schools are the proper place for the study of the surveying and mapping, or geodetic sciences, especially in view of the enlightened shift of emphasis now current in these schools throughout the nation towards science-oriented curricula, plus the added factor of new knowledge of the geoid. The decrease of emphasis on the art of surveying in engineering curricula is not at all inimical to this recommendation; in fact, such decrease may be the very means of providing time for courses in geodetic, photogrammetric, cadastral, topographic and other such fields.

Actually the operation, care, and adjustments of surveying instruments should be handled as the work of technicians and we commend the colleges that give specialized training and/or two-year college programs for such work. However, engineers' responsibilities are more properly defined as the planning, direction and design of surveying and mapping operations.

The Committee agrees that the teaching of the highly specialized aspects of the survey (geodetic or geometronic) engineering field should be restricted to a relatively few universities. However, a course in basic surveying should be included in the curricula of all civil engineering colleges to provide fundamental concepts of geodetic relations, mensuration through the application of surveying techniques, the theory of errors, and the advantages, disadvantages, and restriction of various methods and techniques used in surveying and mapping practice.

F - Conclusions and Recommendations

The following conclusions and recommendations are presented by the Task Committee for approval and action by the Surveying and Mapping Division and for appropriate action by the Society's Board of Direction:

1. That the overall definition of the field of surveying and mapping comprising six principal categories: a) land surveying; b) engineering surveying; c) geodetic surveying; d) cartographic surveying; e) aerial survey services; and f) cartography, all as shown in detail in the attached classification chart (Appendix D) be accepted, and that the difference between professional-level duties and technician-level duties as proposed in the classification chart be recognized.
2. That the first four of the six main categories comprising the overall field of surveying and mapping should continue to be regarded as engineering, these being land or property surveying, engineering surveying, geodetic surveying, and cartographic surveying; that these four categories should be considered as comprising the field of survey engineering (or geodetic engineering, or geometronic engineering), which in turn should be regarded as a branch of civil engineering; and that all State Registration Boards, engineering societies, and similar professional groups should recognize professional-level experience in this field as professional engineering experience.
3. That, with regard to education in this field,
   a) All fully accredited civil engineering curricula should include [redacted] adequate instruction in basic surveying [redacted] by qualified personnel.
   b) Some of the engineering schools throughout the country should provide an elective sequence of surveying and mapping subjects, available in the junior and senior years, totalling 16 to 20 semester hour credits, that would comprise, in effect, a major in survey engineering (or geodetic engineering or geometronic engineering) within the B. C. E. degree, or alternatively, a B. S. degree in such engineering;
   c) That at least one engineering school should offer graduate degree programs in the major specialties of the survey engineering field, such as: land surveying, geodetic, cartographic, and photogrammetric engineering;
   d) That all employers of professional-level surveying and mapping personnel be encouraged to assist those schools that are willing to establish the educational programs listed in (b) and (c) above, by recommending promising students for enrollment, by offering part-time employment to the students, and by employing graduates of such programs.
4. That at some appropriate time in the future, those who wish to engage in the practice of land surveying and related engineering work should first be required to qualify for a professional engineer (P. E.) license, and that ultimately the right to practice

land surveying in any given area would be a moral right based on professional competence and the engineers' code of ethics, rather than a legal right based on separate registration for land surveying; and that all State Registration Boards be encouraged by all concerned to move toward the goal herein envisioned as rapidly as circumstances permit.

5. That all national, state, and local societies or associations of engineers and surveyors be encouraged to cooperate for the purpose of bringing about as rapidly as may be practicable, the ultimate situations contemplated in several of the above items.

.....

The Task Committee gratefully acknowledges the great assistance given by very many individuals and organizations who contributed their views and suggestions during the course of this study and in the formulation of this report. We urge them and all who are interested in the profession to work toward the furtherance of the report's objectives as a means of strengthening the profession in the critical years of the decades just ahead.

Respectfully submitted,

Task Committee on Status
of Surveying and Mapping

Alfred O. Quinn
George D. Whitmore
Brother B. Austin Barry, Chairman

APPENDIX

Reference A

The Report of the Committee on Land Surveying of the National Council of State Boards of Engineering Examiners (NCSBEE) dated 1948 reads thus:

Definition of Land Surveying.

It is the opinion of this committee that the profession of land surveying comprises the determination of the location of land boundaries and land boundary corners; the preparation of maps showing the shape and areas of tracts of land into smaller tracts; including the layout of roads and streets, and rights of way of same, to give access to smaller tracts; and the preparation of official plats or maps of said land subdivisions, in compliance with the laws of the states in which the work is done.

The profession of land surveying also includes the preparation and interpretation of land descriptions for incorporation in deeds, leases and other legal documents, and the application and interpretation of U. S. General Land Office (now the Bureau of Land Management) and court decisions, as such decisions relate to original surveys and resurveys.

Land Surveying does not include engineering surveys, such as those required for the planning and construction of railroads, highways, airports, utility lines and bridges, although the determination of the boundaries of the lands to be used for such engineering construction and the preparation of the legal descriptions of same is land surveying and not engineering surveying.

The surveying necessary for the preparation of a topographic map is engineering surveying and not land surveying.

Reference B

Resolution #1-52 submitted by Land Surveyors Committee (NSPE) 1952

WHEREAS, it has long been held in this country that surveying is a form of engineering; and

WHEREAS, there necessarily exists a close relationship between the professions of surveying and engineering; and

WHEREAS, the profession of surveying itself involves both land or boundary line surveys and engineering surveys; and

WHEREAS, the line of demarcation and the responsibility for the performance of these functions of the surveyor have been a source of doubt and question, often to the detriment of those concerned; and

WHEREAS, A Committee on Land Surveying of the National Council of State Boards of Engineering Examiners has officially propounded reasonable definitions and divisions of responsibility in this regard;

THEREFORE BE IT RESOLVED THAT:

The Land Surveyors Committee of the National Society of Professional Engineers urge that the Board of Trustees of said National Society

(a) endorse said report of the National Council of State Boards of Engineering Examiners, a copy of which is hereto attached;

(b) urge its member State Societies to promote the use and adoption of said report by their State Registration Boards; and

(c) combine its influence and prestige with other interested organizations to promote a uniform, high level, surveyors' registration act throughout the states of this country, with a view toward qualifying registered surveyors in general for membership in the National Society of Professional Engineers.

Reference C

AMERICAN SOCIETY OF CIVIL ENGINEERS

Surveying and Mapping Division

Draft of a Resolution submitted by the Executive Committee of the Surveying and Mapping Division to the Board of Direction of theAmerican Society of Civil Engineers, February 16, 1952, and passed by the Board of Direction at the New Orleans meeting on March 3, 1952.

WHEREAS: the U.S. Civil Service Commission has decreed, in effect that in the operations of the Government's surveying and mapping agencies there is no work that can be considered to be engineering; and

WHEREAS: surveying of all types, and particularly surveying for the purpose of providing data for the production of maps (including geodetic, topographic, hydrographic, and cadastral surveying, as well as surveying techniques utilizing photogrammetry and electronics) have long been considered to be a branch of civil engineering; and

WHEREAS: the Civil Service Commission's order may ultimately affect the standing within the engineering profession of many engineers outside of government service, including members of the faculties of educational institutions, members of private-practice organizations, and engineer employees of state, county, and principal governments; and

WHEREAS: it is believed that a clear statement on this question by the recognized leaders of the civil engineering profession is necessary before any organization can hope to challenge successfully the Civil Service Commission as to the justice and wisdom of its edict;

NOW THEREFORE BE IT RESOLVED THAT:

in the opinion of the Board of Direction of the American Society of Civil Engineers, the planning, execution, and direction of the professional surveying activities that are necessary for the production of the Government's standard series of maps and charts, as well as similar work elsewhere, are professional engineering; and that the public interests which are dependent on the quality, consistency, and economy of such work will be best served if it is directed and performed, as much as possible, by professional engineers having appropriate qualifications.

Reference D

CLASSIFICATION CHART FOR SURVEYING AND MAPPING

	Professional Level***	Technician or Pre-Professional Level****
I. Land or Property Surveying (Cadastral)		
A. Property and Boundary Surveys*	Land Surveyor	Instrumentman
B. Subdivision Surveys and Plats*		Computer
C. Public Lands Surveys*		Draftsman
D. Surveys for Plans and Plats*		Tapeman
1. Architectural (Building-Site) Surveys		Rodman
2. Tax Maps		
II. Engineering Surveys (for Design and Construction)		
A. Design Data Surveys (including Route Surveys)*	Survey Engineer	Instrumentman
1. Control, Horizontal and Vertical		Computer
2. Culture and Topography		Draftsman
3. Profiles and Cross-Sections		Tapeman
B. Construction Surveys*		Rodman
1. Layout Surveys		
2. Quantity and Measurement Surveys		
3. "As-Built" Surveys		
a. Utility Surveys		
C. Mine Surveys		
III. Geodetic Surveying, Geodetic Engineering, or Geodesy (not to be confused with precise plane surveying)		
A. Control Surveys, First- and Second-Order Accuracy**	Geodetic Surveyor or Geodetic Engineer Mathematician	Instrumentman
1. Horizontal: triangulation, traverse, and electronic trilateration		Observer
2. Vertical: spirit and trigonometric leveling		Computer
B. Geodetic Astronomy		Gravimetric Operator
C. Gravity Surveys, Magnetic Declination Surveys, Figure-of-the-Earth Studies		Recorder
		Signalman
		Tapeman
		Rodman
IV. Cartographic Surveying, Cartographic Engineering, or Map and Chart Surveying (surveys for constructing original maps and similar products)		
A. Control Surveys, Third- and Fourth-Order Accuracy**	Topographic Engineer	Plane-Table Operator
1. Horizontal	Hydrographic Engineer	Instrumentman
2. Vertical		Observer
B. Topographic-Planimetric Surveys and Maps*	Photogrammetric Engineer	Computer
1. Photogrammetric Aero-Triangulation	Survey Engineer (Control)	Recorder
2. Mapping Surveys	Geodetic Surveyor or Geodetic Engineer	Draftsman
a. Ground-Survey Methods		Tapeman
b. Photogrammetric Methods		Rodman
3. Field-Edit Surveys of Photogrammetric Compilations		Stereo-Plotter Operator
C. Hydrographic Surveys**		Observer
1. Soundings: fathometer, hand-lead, sounding pole		Recorder
2. Sounding Fixes: three-point, electronic		Computer
3. Wire-Drag Surveys		Draftsman
4. Tidal and Current Surveys		Leadsman
V. Aerial Survey Services		
A. Aerial Photography	Photogrammetrist	Photographer
1. Photo-Interpretation	Photo-Interpreter	Photo-lab Technician
B. Electrical Measurements for distances and position fixes (shoran, etc.)	Electronic Engineer	Photo Analyst
C. Airborne Magnetometer Surveys	Mathematician	Computer
D. Radar-Altimeter Profiles and Elevations	Geophysicist	Electronic Technician
		Magnetometer Operator
		Radar-altimeter Operator
VI. Cartography (not requiring original surveys)		
A. Map Design	Cartographer	Map Compiler
B. Compilation derived from existing source data	Geographer	Mosaicker
1. Evaluation of Maps and Other Source Data	Map Editor	Modeler
2. Nautical and Aeronautical Charts, Topographic and Planimetric Maps, Special-Purpose Maps, etc.		Engraver
3. Photomaps and Mosaics		Lithographer
4. Relief Maps and Models		
5. Radar-Prediction Charts		
C. Map Editing		
D. Map Reproduction		
1. Engraving or equivalent		
2. Lithography		

* Photogrammetric procedures used when applicable on these and other activities.

** Electronic measuring procedures used when applicable on these and other activities.

*** See definitions following this outline. Titles listed are intended to be illustrative, not inclusive.

**** Including some which are normally skilled craftsmen but which sometimes, by reason of special training, are properly considered technicians, e.g., rodman, tapeman, leadsman, signalman, etc.

Definition of Professional Positions

As a guide to the terms used for designating the several professional positions in the preceding outline, it is thought advisable here to include certain definitions. These accord generally with the accepted definitions given in the ASCE Manual No. 34, "Definitions of Surveying, Mapping, and Related Terms" 1954, but are altered somewhat to describe more clearly the particular job function envisioned in this outline.

Land or Property Surveyor determines location of land boundaries; prepares maps showing shapes and areas of land; divides land into smaller tracts, including layout of roads and streets and rights-of-way for same to give access to smaller tracts; prepares official plats or maps of such land subdivisions; prepares and interprets land descriptions for incorporation in deeds, leases, etc.

Survey Engineer obtains information for planning or developing an engineering project and estimating its cost, often recording such information in form of an engineering map or plat.

Geodetic Surveyor (or Engineer) plans, performs, or supervises high-accuracy surveys as well as the computations and adjustments thereof, including such as triangulation, traverse, precise leveling, and astronomic observations, such surveys being of a magnitude that the required accuracy and precision can be obtained only through processes that involve figure and size of the earth.

Survey Engineer (Control) plans, performs, or supervises surveys and computations of horizontal and vertical measurements involving complex network adjustments, etc.

Topographic Engineer plans, performs, or supervises the construction of topographic maps of any scale, contour interval, or accuracy specification, including all surveying procedures and calculations required for such map construction; determines when and whether ground or photogrammetric surveys or various combinations thereof shall be used.

Photogrammetric Engineer or Photogrammetrist plans, performs, or supervises use of photogrammetric instruments and techniques in conjunction with various aspects of surveying, mapping, resource surveys, and the design of photo-interpretation systems.

Cartographer plans construction and compilation of charts and maps of small scale; assembles, evaluates, selects, and directs plotting of data therefor.

Map Editor performs many functions of the cartographer; especially designs form and content of maps; designs criteria for symbolization and nomenclature; reviews manuscript maps as to accuracy, completeness, correctness, and conformity with established standards.

The titles mathematician, electronic engineer, geographer, geophysicist, etc., are not defined here specifically, since they are primarily titles of persons in allied professions whose work only incidentally is in the field of surveying and mapping.

Geodimeter Surveying for California Highways

By JAMES D. CARTER

DIVISION OF HIGHWAYS, CALIFORNIA

IN SEPTEMBER 1957, the Aerial Surveys department of the California Division of Highways, under the direction of L. L. Funk, purchased a Model 3 Geodimeter. The basic function of this instrument would be to establish primary control monuments in the areas of proposed highway locations with sufficient density and convenience to be useful, not only to the photogrammetric mapping contractor, but also to the stakeout and construction parties.

California is a large State, and runs the gamut of topographic and climatic conditions. For this reason, the Division of Highways is decentralized into eleven separate districts, each with its own survey department. As would be expected, the problems and techniques vary with each district. It was, therefore, decided to limit the Geodimeter party to two men, whose functions would be to operate the instrument; train the reflector attendants, who would be recruited from the local survey parties; and advise the districts in matters pertaining to the Geodimeter. Each district would do the reconnaissance, measure the horizontal angles, and complete all computations after the Geodimeter distances were furnished.

At first this system had definite disadvantages, because each district in turn had to become acquainted, on the job, with the instrument and to develop a method of handling manpower, equipment, terrain, and climatic problems in a minimum of time, as the Geodimeter usually has a "waiting list."

Since we have worked in all but two of the districts, the experimental phase is now nearing an end, with the result that we have a large number of men throughout the State who are competent in one or more phases of Geodimeter surveying.

Presented at the 18th Annual Meeting of the American Congress on Surveying and Mapping, Washington, D. C., March 24–26, 1958.

METHODS

At present two basic figures are standard. That of a traverse, with side-shots where necessary, which originates and closes upon Coast and Geodetic control; and polar surveying, where the Geodimeter occupies a single station and observes radial lines. The vertical angles, for slope reduction, and occasionally the horizontal angles, are measured coincident with the Geodimeter observation, using the reflectors as targets. The reflectors will yield a sharp image, with no halo, at fifteen or more miles when illuminated by a five-cell flashlight at the theodolite.

The survey is usually planned so that the instrument is observing on one reflector while the other two are being relocated. This results in a maximum use of observing time, because the Geodimeter can immediately be centered on the next reflector and another measurement started. Often several stations along the traverse can be observed in this manner.

In polar surveying, the measurement process can be carried out without interruption until all points have been observed; the only exception being when all the reflectors are required to be at the end of a very long line. Each line will require from thirty minutes to one hour of observing time. Setup and travel time will vary with the difficulty of the terrain.

Because many of our traverses are located along major highways, and some points are in median strips, we were concerned that background lights would be a problem. Due to the narrow acceptance angle of the Geodimeter, however, this happens rarely, and is often rectified merely by changing the height of the reflector tripod. We have

traversed under neon signs, between street lamps, and over cities with no difficulty. The only exception to this is the condition where the line of sight falls for a considerable distance along the shoulder of a busy highway when a dense smog condition exists. The oncoming headlights will then have a halo around them, which may cause a temporary interference.

A typical traverse will run about twenty miles, with monuments placed at one- to four-mile intervals along the proposed route.

ACCURACY

Before discussing accuracy, it should be explained that this instrument produces an error of a type not previously encountered in surveying. The error has proved to be accidental, nonsystematic, and not proportional to the distance measured. Such an instrument should be evaluated not only on the basis of what the average or "working" error will be, but also as to what extremes can be expected.

We have determined that our Geodimeter has a mean error of approximately plus or minus 0.2 foot, and may vary from zero to a maximum error, under extremely adverse conditions, of 0.5 foot. An instrumental error as large as one foot is a practical impossibility.

The observing procedure affords a check while the measurement is in progress, therefore, any possible malfunction is immediately detected. An additional check on the all-important last four digits of the distance is provided during the final computation, and tends to eliminate arithmetic blunders. It is interesting to note that such blunders would produce only very large even errors, such as 200 meters exactly, or 4,000 meters exactly. Such errors are easily detected and corrected during the traverse computation, thus making it unnecessary to return to the field.

RESULTS

The error of closure will depend to a large extent upon the quality of the control ties. Our closures have varied between 1:25,000 and 1:60,000 when based on secondary scheme quadrangles of the Coast and Geodetic Survey, and about 1:100,000 when observing across a main scheme net.

A recent 25-mile traverse, with nine stations in the main scheme, was checked by a two-line measurement between the end points. The resulting error of closure was 1:250,000, which indicates the lack of a systematic error and the high degree of dependability, as this traverse ran through rough terrain, with strong, cold winds, occasional rain, and differences of elevation up to several thousand feet. The air was quite turbulent and large differences of temperature existed along the lines.

We have now used the Geodimeter continuously for seven months of winter, under a wide range of conditions. Approximately 200 lines have been measured, covering a total distance in excess of 600 miles. The minimum line was 1,200 feet long, and the maximum distance observed has been 17 miles, against a light ground haze and a full moon. Lines of eight miles have been measured in a light rain and lines two to four miles in length have been measured in very heavy downpours.

On several occasions, measurements have been made through brush and trees that we were not aware of until later; enough light had filtered between the leaves to operate the instrument. High winds have not been a problem. The Geodimeter operated successfully throughout one night during which a house trailer was blown from a nearby road, causing the road to be closed to truck traffic.

COSTS

A cost comparison is difficult because of the variations in methods and equipment in each district, and also because we are attempting to compare first-order work against the expense of second- and third-order surveys on an even basis. In level, unobstructed terrain, the savings will be from thirty to fifty percent and in rough, mountainous terrain, the savings will be much higher. A conservative estimate of savings to the Division of Highways, based on reasonably continuous use, should be over $100,000 per year.

Other than replacing a projector lamp occasionally, maintenance costs have been negligible, and probably will continue to be so. The instrument has been subjected to rather rough handling, even dropped, with no apparent effect.

CONCLUSION

The various district survey departments appear to be more than satisfied with the quantity and quality of the work accomplished. Their technical horizons have been considerably broadened. They can now correct or bypass the lowland survey points found to be of dubious quality, to which they were formerly restricted, and can now easily carry their traverses into, or even beyond, mountains, if necessary, to utilize the best control available. Lakes and narrow canyons, where triangulation has been awkward, are no longer a problem. The tedious and time-consuming adjustment of quadrilaterals has been eliminated, sideshots can be trusted to a high degree, and the traverse always closes. The Geodimeter has proved itself to be a highly practical and unusually dependable tool.

New Deep in Lake Superior

The U. S. Lake Survey hydrographic party aboard the Motorship *Williams* has discovered a new low spot in the bottom of Lake Superior. This newly discovered deep is about three-fourths of a mile wide, with bottom depths of 600 and 800 feet on either side. It is located in United States waters and is off the Marquette-Munising area of Michigan, in Lat. 46° 54′ 45″ N., and Long. 86° 36′ 15″ W. The position of the deep was fixed by means of Shoran electronic positioning equipment. Maximum recorded depth is 1333 feet.

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The Tape Comparator at the University of California

By FRANCIS H. MOFFITT

ASSOCIATE PROFESSOR OF CIVIL ENGINEERING

THE Physical Standards Laboratory of the University of California has developed instrumentation and techniques for the comparison of tapes used in engineering and surveying against a pair of secondary standards. With the tape comparator, the Standards Laboratory can prepare a report on a tape sent in for comparison according to the following types of comparison.

1. Determine the distance to the nearest 0.001 foot between the 0- and 100-ft. graduations of a 100-ft. tape when supported throughout its entire length, at 68° F., and under the tension, or pull, requested by the user.
2. Determine the tension to the nearest ¼ pound required to make the horizontal distance between the 0- and 100-ft. graduations of a 100-ft. tape measure 100.000 feet when supported throughout its entire length, at 68° F. An exception to this type of comparison is where the tape is inherently long and where less than 5 pounds is required to make the tape measure 100.000 ft.
3. Determine the distance to the nearest 0.001 ft. between the 0- and 100-ft. graduations of a 100-ft. tape when supported at the two ends only, at 68° F., and under the tension, or pull, requested by the user.
4. Determine the distance to the nearest 0.001 ft. between the 0- and 100-ft. graduations of a 100-ft. tape when supported at two ends and at any other additional supports specified by the user, at 68° F., and under tension requested by the user.
5. Determine the tension to the nearest ¼ pound required to make the distance between the 0- and 100-ft. graduations of a 100-ft. tape measure 100.000 feet when supported at the two ends only, at 68° F. An exception to this type of comparison is where the tape is inherently long and where the tension is so small as to cause more than 3 feet of sag at the midpoint of the tape.
6. Determine the tension to the nearest ¼ pound required to make the distance between the 0- and 100-ft. graduations of a 100-ft. tape measure 100.000 feet when supported at the two ends and at any other additional support specified by the user, at 68° F. An exception to this type of comparison is where the tape is inherently long and where less than 5 pounds is required to make the tape so supported measure 100.000 feet.
7. Determine the distance to the nearest 0.001 ft. between the 0- and 100-ft. graduations and between the 100- and 200-ft. graduations of a 200-ft. tape when supported throughout its entire length, at 68° F., and under the tension requested by the user.
8. Determine the distance to the nearest 0.001 ft. between the 0- and 100-ft. graduations and between the 100- and 200-ft. graduations of a 200-ft. tape when supported at the 0-, 100-, and 200-ft. marks, at 68° F., and under the tension requested by the user.
9. Determine the distance to the nearest 0.001 ft. between the 0- and 100-ft. graduations and between the 100- and 200-ft. graduations of a 200-ft. tape when supported at the 0-, 100-, and 200-ft. marks and at any additional supports specified by the user, at 68° F., and under tension requested by the user.
10. Determine the distance to the nearest 0.001 ft. between any multiple 100-ft. length graduations of 300-, 400-, or 500-ft. tapes under any condition of support (supported throughout or supported at specified points including the 100-ft. points), at 68° F., and under the tension requested by the user.

It should be noted that, for any tape other than a 100-ft. tape, the Standards Laboratory will not determine the tension necessary to make a given tape measure a specified length under given conditions of support. This type of comparison is outside the physical capacity of the tape comparator. However, the tension may be computed by the user or owner of the tape to a fairly high degree of accuracy or reliability by the well-known tape correction found in textbooks on surveying.

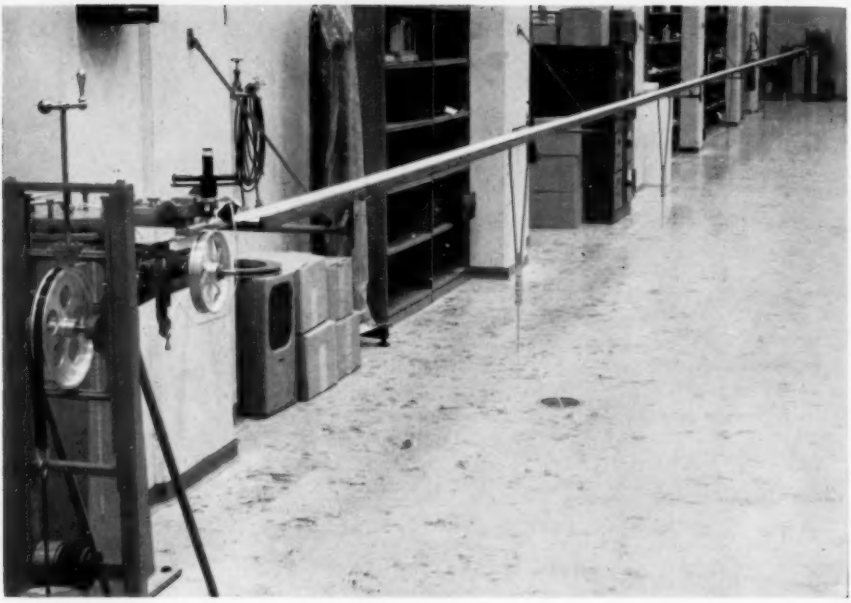

FIGURE 1.

The secondary standards used in the comparator are two specially manufactured and specially graduated steel tapes, one prepared by the Keuffel and Esser Company and the other by the Lufkin Rule Company. They are graduated at the 0-, 50-, and 100-ft. marks only. The graduations are 0.003 inch wide.

The Keuffel and Esser Tape No. 820, which carries the National Bureau of Standards No. 10984, is used first in the comparator, supported throughout on a horizontal flat surface, vibrated by a motor to relieve any friction, and under a tension of 22 pounds at 68° F. The microscopes of the comparator are set on the 0- and 100-ft. marks, placing the crosshairs 100.0006 $\pm$ 0.0003 feet apart.

The Lufkin Tape No. 2066, which carries the National Bureau of Standards No. 10983, is then placed in the comparator, supported throughout on a horizontal flat surface, vibrated by a motor to relieve any friction, and under a tension of 22 pounds at 68° F. The microscopes are moved to the 0- and 100-ft. marks, and the travel of the microscopes is recorded to the nearest 0.0001 ft. Applying the net change in the spacing of the microscopes to the original spacing of 100.0006 feet gives the new spacing which should compare with that certified by the National Bureau of Standards, namely, 100.0011 $\pm$ 0.0003 feet. In this manner, the Standards Laboratory is able to determine any growth of the metal of either or both tapes, unless, however, they are both growing at the same rate and in the same direction.

Finally, the tape to be compared is placed in the comparator under the desired method of support and tension, and the travel of the microscopes is recorded. The net travel is applied to the 100.0011-ft. spacing of the microscopes to give the results necessary for the tape report.

The accompanying photographs show some of the features of the comparator. Figure 1 shows an over-all view with the left microscope and tension system in the foreground, and the trough which supports the tape in the supported-throughout con-

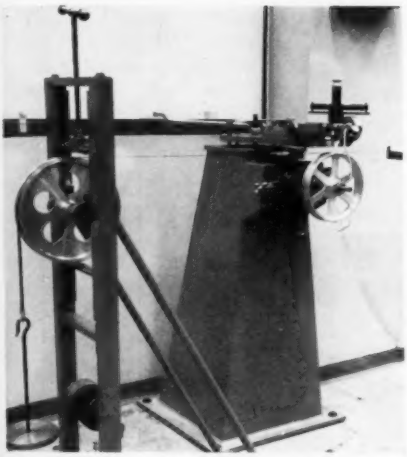

FIGURE 2.

dition. The trough is removed and the trough brackets are swung up and out of the way when the tape is to be suspended between the two ends only. Figure 2 shows a closeup of the left microscope system and the tension system. Figures 3 and 4 show closeups of the right microscope system, together with the wall bracket which holds the tape and allows for its movement under the microscope. In Figure 3, a tape is being supported throughout its length on the trough. In Figure 4, the tape is supported at the two ends only.

When a person wishes to have a comparison made on his tape by the University of California's Physical Standards Laboratory, he must follow the procedure outlined below.

1. Write to the Institute of Engineering Research, University of California, Berkeley 4, California, attention of Mr. Harry Sylvis, stating that he desires a tape (give its length) compared. He must state specifically what type or types of comparisons are to be made. These are outlined above.
2. The Institute of Engineering Research will forward forms to be completed, together with a statement of cost and request for full payment for the comparison.
3. Send the completed forms, the payment, and the tape, or tapes, to the Institute of Engineering Research.
4. Upon receipt of these items, the Physical Standards Laboratory will perform the tape comparisons.
5. The Institute of Engineering Research will then return the tape, together with the report on the tape.

Unless the sender is specific as to what type of comparison is desired, the Institute of Engineering Research must then write a letter asking for more information before

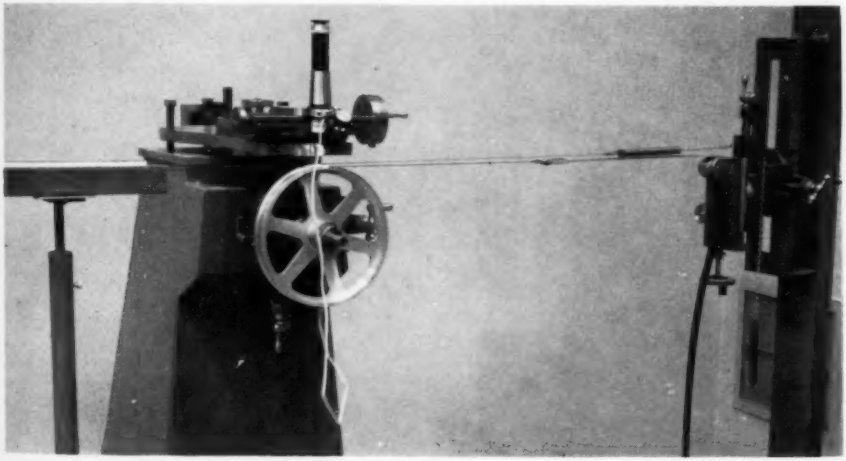

FIGURE 3.

the fee can be established, thus delaying the comparison.

Fees for comparing tapes in the University of California's Physical Standards Laboratory are compatible with those charged by the National Bureau of Standards. It is very difficult to set any standard fee for a given type of comparison, because the user may wish to have more than one tape compared or more than one type of comparison made. This would affect the base fee in a way which can be determined only when the Standards Laboratory knows what comparisons are to be made. Consequently, a person desiring a fee quotation should write to the Institute of Engineering Research, stating the information regarding his tape or tapes.

The time lapse between receipt of a tape by the Standards Laboratory and its return to the owner varies from one to three weeks. If the occasion arises, the owner may bring the tape directly to the Standards Laboratory, located in Cory Hall on the Berkeley Campus, complete the necessary forms, pay the fees, and have a tape compared in a matter of a few days, depending on workload conditions in the laboratory at the time.

Anyone desiring additional information on the tape comparator should direct inquiry to Mr. Sylvis, in care of the Institute of Engineering Research.

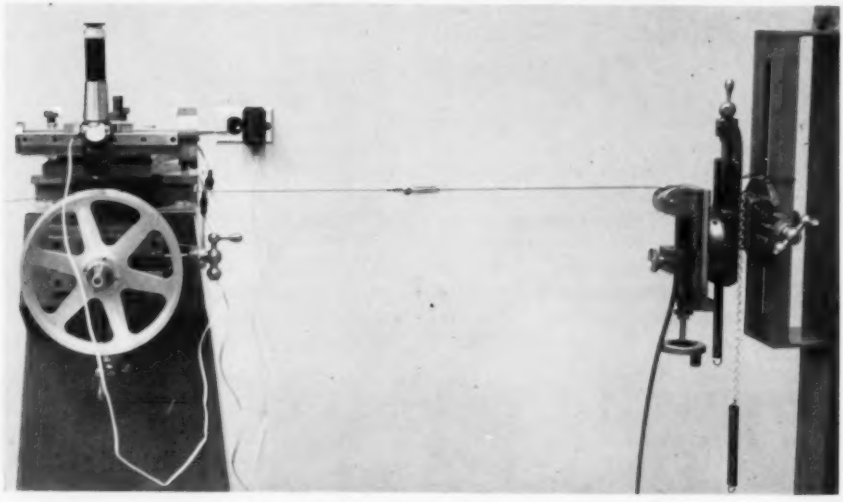

FIGURE 4.

"How to Secure the Services of a Land Surveyor"

The Massachusetts Association of Land Surveyors and Civil Engineers has published, and is distributing through its five regional associations, a small pamphlet bearing the title "How to Secure the Services of a Land Surveyor." This pamphlet, published and distributed as a public service, covers, in question-and-answer form, the following topics—How do I choose a surveyor?, How much will a survey cost?, What will a land surveyor do for me?, How do I authorize a survey?, Definitions of types of surveys, and Surveyor-Client relations. This little publication should do much to improve the relationships between property holders and surveyors and to smooth the paths trod by both groups.

Maps of Distinction

By WALTER W. RISTOW

MAP DIVISION, LIBRARY OF CONGRESS

EDITOR'S NOTE.—Dr. Walter W. Ristow, whose interesting analysis of SURVEYING AND MAPPING'S *Distinctive Recent Maps* feature follows, has served the American Congress on Surveying and Mapping for many years, both ably and faithfully. As set forth in this article, he has contributed the *Distinctive Recent Maps* feature for ten consecutive years. He has also contributed many interesting short items, as well as a major paper, "Journalistic Cartography," (*See* SURVEYING AND MAPPING, October–December 1957, Vol. XVII, No. 4, pages 369–390.) ACSM and its Journal are indebted to Dr. Ristow for his great interest and the many, many hours spent in preparing copy for SURVEYING AND MAPPING.

A POPULAR BRAND of distilled spirits was promoted several years ago, in a series of magazine advertisements featuring "Men of Distinction." Such famed personages as Carveth Wells, Hassoldt Davis, and Sir Hubert Wilkins were pictured, in appropriate dress and surroundings, expertly raising a tall glass filled with a clear golden liquid. Almost invariably included in the display was an attractive map or globe.

The captive viewer was left to ponder the question of whether the man magnanimously shared his fame with the map, or if the latter reflected added luster on the distinguished one. As a cartophile of long standing, I prefer to accept the second premise for, over the centuries, maps and globes have achieved a measure of distinction in their own right.

Using maps as symbols of learning and prestige is not a recent development. Many artists have recognized the value of cartographic props and have incorporated into their paintings representations of globes and maps. Johannes Vermeer, seventeenth century Dutch painter, showed an exceptional interest in cartography by including a map or globe in at least ten of his canvasses. Pieter de Hoch and Nicolaes Maes, of the same period, also portrayed maps in some of their works. Maps and a globe occupy prominent positions in Edward Savage's large painting of "The Washington Family" at the National Gallery of Art in Washington, D. C. Such modern artists as Covarrubias, Dali, and Rivera have also made effective use of maps in certain of their paintings.

Maps, globes, and surveying instruments likewise add a tone of distinction to the portraits of many seventeenth and eighteenth century explorers, navigators, and mapmakers. A likeness of the great Gerardus Mercator, surrounded by tools of the mapmaker's trade, serves appropriately as a frontispiece in the first *Mercator Atlas*, published in 1595. Later editions of the atlas feature an illustration of Mercator seated with his associate and successor Jodocus Hondius, at a table upon the surface of which there is an assortment of cartographic instruments, maps, and globes.

But, I am wandering from my subject. The point I wish to make is simply that maps—at least the best of them—can stand on their own merits. Like the VIP's in the liquor ads, some among them may, for various reasons, be selected as "distinctive" within the family of maps. Over a period of years a representative group of such cartographic VIM's (i.e. Very Important Maps) have been introduced to readers of this Journal under the heading, *Distinctive Recent Maps*.

The first selections made by this contributor were published in the October–December 1948 issue of SURVEYING AND MAPPING. It seems appropriate, therefore, after ten years of contributions, to review and analyze the maps which have been described in this cartographic "Who's Who," and to note some of the criteria and considerations observed in selecting them.

Originator of the *Distinctive Recent*

Maps feature is Dr. John K. Wright, distinguished student of geography and cartography, and former Director of the American Geographical Society of New York. Dr. Wright's first selection of seven maps was published in the January 1945 issue of this Journal. In introducing the new department the Editor noted that "SURVEYING AND MAPPING is grateful to Dr. Wright for volunteering to contribute regularly information on recent map contributions."

For the succeeding two years, Wright did "contribute regularly" and some six or seven *Distictive Recent Maps* appeared in every issue except that of October–December 1946, which was largely devoted to a Directory of ACSM members. Because of increased professional and administrative responsibilities, Dr. Wright found it necessary to discontinue his contributions with the selections published in the July–December 1947 number of SURVEYING AND MAPPING.

An invitation from the Chairman of the Publications Committee, to assume responsibility for *Distinctive Recent Maps* was naively accepted by the writer shortly thereafter, and his first maps were described in the Journal's October–December 1948 number. With two exceptions (the October–December issues for 1949 and 1950) subsequent issues of SURVEYING AND MAPPING have included selections. To date some 800 maps have been described, an average of 20 per issue.

Selections are made from the maps regularly acquired by the Library of Congress Map Division. During the past decade the Library's annual receipts of new cartographic publications have averaged over 40,000 maps. Every month some 3,500 items are added to the collections of the Library.*

To select 20 distinctive items from among the 10,000 maps acquired each quarter is, obviously, no simple task. The Editor and Publications Committee Chairman having prescribed no selection standards, the decision on what maps to list and which to exclude has been the sole responsibility of the writer. Inevitably his interests, prejudices, and preferences are reflected in the choices that have been made.

It must be confessed that no ironclad rules have been observed. A sincere attempt has been made to list those maps which, in his opinion, might interest the greatest number of readers of SURVEYING AND MAPPING. That this goal has been achieved, in part at least, is evident from the number of requests received from correspondents desiring additional data on how to obtain specific items described in *Distinctive Recent Maps.* Publishers, apparently assured that this feature is read, frequently send in new maps for possible inclusion in the quarterly list.

Several categories or types of maps are, with some exceptions, automatically eliminated. They include new sheets of standard large or medium scale topographic, hydrographic, or aeronautical map or chart series published in this country or abroad. Interesting new series, or distinctive individual sheets (e.g. some of the shaded relief quadrangles of the U. S. Geological Survey, or special sheets of the British Ordnance Survey issued for use by tourists) are however, described.

Maps printed in limited blue print or blue line print editions (e.g. the maps prepared for oil prospecting and development purposes by several mapmakers in western and southwestern United States) are also not considered. Road maps distributed through gasoline service stations are not customarily described. An automobile touring map featuring a new technique or method of presenting information might, however, be included.

Because their interest is limited to a rather small percentage of the ACSM membership, city maps or plans are only rarely listed. Exceptions may be made to call attention to such items as the new series of city and vicinity maps published by the Geological Survey, a particularly interesting or attractive plan of some major city of the world, a facsimile of a historic map,

* Annual reports on Map Division acquisitions are published each year in the August issue of the *Library of Congress Quarterly Journal of Current Acquisitions,* available from the Superintendent of Documents, Government Printing Office.

or the presentation of land use, zoning, economic planning, traffic flow, or other special subject data.

Having reported what *Distinctive Recent Maps* do not include, let us now examine the 800-odd maps described over the past decade to ascertain the characteristics of those which have been selected. As might be expected in an American journal, maps of the United States and its major divisions rank high, constituting approximately 15 percent of the total. About the same number were selected for individual States, cities, and territorial possessions. These two groups combined accounted for 30 percent of the "distinctives." Maps of Greenland, Canada, and North America bring the total for this continent (excluding Mexico and Central America) to 35 percent of the total.

The relatively low cartographic production, as well as the secondary significance of Latin America in post-World War II international politics, are reflected in the small percentage (about 5 percent) of maps described for the western hemisphere countries "south of the border." Similar factors explain the figure of only 3 percent for the Australia-Oceania region.

Europe, with its long-established commercial and official mapping organizations, and its continuing importance in the "cold war" contributed approximately 20 percent of the maps selected. Five percent of the selectees are for the Middle East, an indication of the interest in that troubled area in recent years. Restrictions on export of maps from "Iron Curtain" countries limited descriptions of maps of the U. S. S. R. and her satellites to but 2 percent of the total number.

The growing importance of Africa in world affairs is apparent in the number of maps (10 percent) of that continent or its parts. It should be pointed out that many of the maps for this area are still produced in Europe or under the supervision of European surveyors and cartographers.

Export restrictions, internal problems, and publication in lanquages unfamiliar to most readers of SURVEYING AND MAPPING are contributory factors in the low percentage (seven) of Asian maps listed. A renewed interest in Antarctica, related to activities of the International Geophysical Year, resulted in one percent of the selections representing that ice-covered region. Eight percent of the maps described covered the entire world.

From the viewpoint of subject, approximately 12 percent of the selections were the general reference type map, which in some instances combined generalized relief with such customary cultural information as boundaries, towns and cities, and transportation and communications networks. A great variety of distributional and subject data are covered in the remaining 88 percent. Under the general heading of "physical" were described maps featuring topography and relief, geology, weather and climate, soils, vegetation and forests, mines and minerals, and oil and gas. This group accounted for 35 percent of the total.

Economic, agricultural, industrial, and transportation and communications maps comprise 28 percent. Cultural and social subjects include maps on archaeology, languages, races, religions, population, diseases, Indians, folklore, and history, as well as for such recreational interests as art, literature, stamps, treasure, and touring. Some 25 percent of the choices were in this group.

This rather brief analysis points up the fact that maps, like people, may achieve distinction and make contributions in many and varied ways. To the market research specialist a trading area map is distinctive, while the oil prospector desires maps showing land ownership and subsurface structure. The gas station road map is indispensable to the motorist and the air pilot navigates with aeronautical charts. Disease maps aid the public health worker and the farmer makes effective use of soil, vegetation, and irrigation maps. Highway engineers, regional planners, and real estate developers must have detailed large scale topographic maps, while the census enumerator is guided by accurate street plans in urban and suburban areas. In short, the

most useful map is one which provides the best and most complete information for solving the specific problem in hand.

Notwithstanding, some maps do stand out as significant from among the volume of cartographic output. The world may be effectively portrayed on a novel and interesting projection, new techniques for representing relief may be featured, population distribution may be shown for a country not previously so mapped, or newly recognized or established boundaries are delimited. A popular tourist region might be attractively portrayed on a pictorial map, a rare historical work may be republished in facsimile, and the results of months or years of careful surveys are presented on a new geological or mineral map. For some such contribution to geographic knowledge, or cartographic execution, a map is admitted to the exclusive columns of *Distinctive Recent Maps.*

Cromwell Current

A new "river in the sea" has been mapped by scientists of the University of California's Scripps Institution of Oceanography and the U. S. Fish and Wildlife Service's Pacific Ocean Fishery Investigations. Unlike the well-known surface currents that appear on maps of the oceans, this is a subsurface current. Measurements show that it is as strong as a thousand Mississippi Rivers and as swift as the Gulf Stream. It flows eastward along the equator for at least 3,500 miles.

Under the auspices of the National Academy of Science's IGY Committee, the research vessels *Horizon* of the Scripps Institution and *Hugh M. Smith* of the Pacific Oceanic Fishery Investigations recently spent almost two months at the equator. The cruise was called the Dolphin Expedition. At the intersection of longitude 140° West with the equator the ships spent twenty-two days measuring the currents from the surface to a depth of more than 3,000 feet.

Only a hundred feet beneath the west-flowing South Equatorial Current at the surface, Dolphin Expedition located and measured the east-flowing undercurrent.

The very existence of the undercurrent has been known for only a few years. A U. S. Fish and Wildlife Service vessel studying long-line fishing discovered it. This technique of fishing, originated by the Japanese, requires that a series of fishing lines be attached to a rope several miles long which is supported near the surface by buoys. When the research vessel put out its line at the equator, it found that the line did not move westward with the surface current, as expected, but at high speed in exactly the opposite direction.

In 1952, Townsend Cromwell, then with the Fish and Wildlife Service, located the current at the equator and longitude 150° West. In 1955, the Scripps Institution's Eastropic Expedition made a few measurements. But until Dolphin Expedition it was not known how far east the current extends, how deep it is, how wide it is, or how fast it flows. Dolphin Expedition answered these questions. It extends east to the Galapagos Islands; its core lies about 300 feet beneath the surface, becoming shallower toward the east; it is about 250 miles wide; and its speed is about three knots.

Townsend Cromwell was killed in an airplane crash in Mexico on his way to join another Scripps expedition just three days after the Dolphin Expedition completed its measurements of the current he discovered. Fellow oceanographers at Scripps hope that the under current will be called the Cromwell Current in his memory. This would follow the precedent of the great north-flowing current off western South America, which is often called the Humboldt Current after its discoverer, the German scientist Alexander von Humboldt (1769–1859), and the inshore countercurrent off California which is called the Davidson Current after George Davidson (1825–1911), who as a member of the U. S. Coast and Geodetic Survey took part in the coastal survey of California.

Surveying and Mapping News

Members are requested to send in surveying and mapping news items for publication in SURVEYING AND MAPPING.—EDITOR.

CURRENT SURVEYING AND MAPPING LITERATURE

MAGAZINE ARTICLES

General Interest

MODERN TECHNIQUES OF GEODETIC AND TOPOGRAPHIC SURVEYING. B. P. Lambert. *The Australian Surveyor*, Vol. 17, No. 1, March 1958. (Nontechnical but well organized and well presented.)

CENTENARY OF SYDNEY OBSERVATORY, May 1958. H. C. Nightingale. *The Australian Surveyor*, Vol. 17, No. 2, June 1958. (History of the observatory from the planning stages to the present.)

NORTH CAROLINA SOCIETY OF ENGINEERS, DIRECTORY OF MEMBERSHIP. Included in *North Carolina Engineer*, Vol. 14, No. 4, July 1958. (Includes directories of professional societies, engineers' clubs, and state boards.)

UBERSICHT DER LITERATUR FUR VERMESSUNGSWESEN UND KULTURTECHNIK DES JAHRES 1957 MIT EINZELNEN NACHTRAGEN AUS FRUHEREN JAHREN. *Zeitschrift fur Vermesungswesen*. 83 Jahrgang, Heft 8, August 1958. (Bibliography of literature on surveying, mapping, and related subjects published during 1957 with extracts from previous years. Foreword and other introductory material in German. Titles in languages of origin.)

Cartography

CONTEMPORARY CARTOGRAPHY; CUMBERLAND COUNTY COUNCIL. K. W. Glover. *Cartography*, Vol. 2, No. 2, September 1957. (Discusses part played by topographic mapping in town planning.)

ADDRESS BY PROFESSOR SCHERMERHORN. Dr. Ing. W. Schermerhorn. *Cartography* (Journal of the Australian Institute of Cartographers, Kelvin Hall, 55 Collins Place, Melbourne, Victoria), Vol. 2, No. 2, September 1957. (Address on relation of photogrammetry to cartography given at joint meeting of Institute of Cartography and Institute of Surveyors at the University of Technology, Sydney, 30 August 1957.)

CARTOGRAPHY AND THE DEVELOPMENT OF PHOTO-LITHOGRAPHY. B. E. Goodrick. *Cartography*, Vol. 2, No. 2, September 1957. (Reviews history of reproduction processes through photolithography to modern offset methods.)

XEROGRAPHY AND ELECTROSTATIC PRINTING. K. A. Metcalfe and R. J. Wright. *Cartography*, Vol. 2, No. 2, September 1957. (Discussion and descriptions of printing methods employing electronic techniques identified under the generic term "xerography".)

MAPS, MAP MAKING, AND USE OF MAPS. G. C. Irving. *The Australian Surveyor*, Vol. 17, No. 1, March 1958. (Discusses subjects in broad outline designed as frame of reference for more detailed lectures.)

PIONEER MAPS OF HEALTH AND DISEASE IN ENGLAND. E. W. Gilbert. *The Geographical Journal*, Vol. 74, Part 2, June 1958. (Discussion of early maps showing distribution of diseases tied in to the present interest in medical geography.)

A PROPOSAL FOR THE STANDARDIZATION OF SCALES OF MAPS IN CARTOGRAPHY. B. Goussinsky. *Empire Survey Review*, Vol. 14, No. 109, July 1958. (Describes a possible method for obtaining uniformity and discusses advantages of standardization.)

KENTUCKY'S KING-SIZE MAP. Charlotte Baumgarten. *The Commonwealth*, Vol. 2, No. 4, July 1958. (Popular article dealing with the completed topographic mapping, at the scale of 1:24,000, of the entire State of Kentucky.)

IMPROVED MAP PAPER. (No author named.) *Technical News Bulletin, National Bureau of Standards*, Vol. 42, No. 8, August 1958. (Describes research and development by the Bureau for Army Engineer Research and Development Laboratories to produce a map paper of high-dimensional stability for special military maps and charts.)

MAPS. Walter W. Ristow and Catherine I. Bahn. *The Library of Congress Quarterly Journal of Current Acquisitions*, Vol. 15, No. 4, August 1958. (Annual report of the Map Division, Library of Congress.)

THE CHARTING OF THE SCOTTISH COASTS. A. H. W. Robinson. *The Scottish Geographical*

Magazine, Vol. 74, No. 2, September 1958. (Historical discussion of problems and operations from 1693 onward.)

Control Surveys

GEODIMETER BASE LINES. Harold E. Jones. *The Canadian Surveyor*, Vol. 14, No. 2, April 1958. (Discusses Geodimeter operations and compares results with Tellurometer surveys.)

A GENERAL CHECK FOR TRIANGULATION COMPUTATION. Dr. Bogomil Cvetkov. *Empire Survey Review*, Vol. 14, No. 108, April 1958. (Mathematical discussion.)

CURRENT ADJUSTMENT AND POTENTIAL ADJUSTMENT OF METHODS APPLIED TO THE ADJUSTMENT OF LEVEL NETS. Hsuan-Loh Su. *Empire Survey Review*, Vol. 14, No. 108, April 1958. (Mathematical discussion.)

THE LEAST SQUARES ADJUSTMENT OF GEODETIC FIGURES WITH OBSERVED ANGLES AND MEASURED SIDES. B. T. Murphy. *Empire Survey Review*, Vol. 14, No. 108, April 1958. (Sets forth new proposals for better solution to well-known problem.)

AN EMPIRICAL INVESTIGATION OF ATMOSPHERIC REFRACTION. A. Thom. *Empire Survey Review*, Vol. 14, No. 108, April 1958. (Report on attempt by field observations to produce constants which may help to give more reliable values of the coefficient of refraction.)

FIELD SURVEYS FOR MAPPING. Desmond O'Connor. *The Australian Surveyor*, Vol. 17, No. 2, June 1958. (Very compact and interesting discussion of the various elements and techniques of topographic surveying.)

"OSCAR" CAN CUT ROAD COSTS BY MILLIONS. Unsigned. *Engineering News-Record*, Vol. 160, No. 25, June 19, 1958. (Describes Automatic Scanning Correlator, an electronic device applied to photogrammetric stereoplotting.)

AZIMUTH CONTROLLED ALMUCANTAR OBSERVATIONS FOR POSITION. G. J. Thornton-Smith. *Empire Survey Review*, Vol. 14, No. 109, July 1958. (Discusses theory and application of an observation for astronomical latitude and longitude in which relative directions of several stars are measured in addition to the more usual measurements of zenith distances and instants.)

FIRST-ORDER TRAVERSING WITH THE TELLUROMETER. G. J. Humphries and H. H. Brazier. *Empire Survey Review*, Vol. 14, No. 109, July 1958. (Account of a Tellurometer project carried out in Kenya, Africa.)

RAYDIST LOCATES BORING SITES FOR CHESAPEAKE CROSSING. Allen L. Comstock and P. Z. Michner. *Civil Engineering*, Vol. 28, No. 7, July 1958. (Describes use of electronic equipment in determining characteristics of undersea foundation under Chesapeake Bay.)

Education

EDUCATION FOR SURVEYORS. S. H. de Jong. *The Canadian Surveyor*, Vol. 14, No. 2, April 1958. (Examination of problems to be faced, with suggested solutions.)

CIVIL ENGINEERS AND THE LAW OF SUPPLY AND DEMAND. Professor Robert T. Howe. *Civil Engineering*, Vol. 28, No. 7, July 1958. (Compares engineer supply and demand with economic law of equilibrium price.)

HOW CAN ENGINEERING TEACHING BE IMPROVED? Charles E. Carver, Jr. *Civil Engineering*, Vol. 28, No. 8, August 1958. (Discussion of various techniques considered necessary to sound pedagogy in engineering instruction.)

Instruments

MODIFICATIONS OF THE TELLUROMETER. A. G. Mungall. *The Canadian Surveyor*, Vol. 14, No. 2, April 1958. (Suggests conversion to enable use of the instrument in forested areas.)

NOTE ON THE TELLUROMETER. L. E. Howlett. *The Canadian Surveyor*, Vol. 14, No. 2, April 1958. (Warns of certain limitations which may be expected in Tellurometer operations.)

Property Surveys

THE CO-ORDINATION OF CADASTRAL SURVEYS IN THE STATE OF VICTORIA. B. T. Murphy. *The Australian Surveyor*, Vol. 17, No. 1, March 1958. (Suggests solution for main difficulties in effecting coordination.)

SOME ASPECTS OF URBAN RENEWAL. Stanley H. Pickett. *The Canadian Surveyor*, Vol. 14, No. 2, April 1958. (Discussion of a subject of considerable interest to land surveyors.)

WATER BOUNDARIES. M. Viminitz. *The Canadian Surveyor*, Vol. 14, No. 2, April 1958. (Discusses the rights of property abutting on bodies of water.)

COORDINATION OF CADASTRAL SURVEYS IN THE STATE OF NEW SOUTH WALES. R. V. Bayliss. *The Australian Surveyor*, Vol. 17, No. 2, June 1958. (Reviews accomplishments in the field of coordinating official surveys for the benefit of cadastral and other local survey operations.)

A METHOD FOR RESECTION COMPUTATION. K. R Basu. *Empire Survey Review*, Vol. 14, No. 109, July 1958. (Describes and illustrates suggested method.)

SOLUTION OF THE POSITION LINE PROBLEM: A FURTHER DEVELOPMENT OF THE "RATE OF CHANGE OF LATITUDE" METHOD. G. B. Tait. *Empire Survey Review*, Vol. 14, No. 109, July 1958. (Describes graphical construction for obtaining a solution to the position-line problem; illustrates and describes construction of a nomogram to simplify calculation of rate of change of hour angle with change of latitude; and presents an example to demonstrate application of method to a specific problem.)

BOOKS AND PAMPHLETS

ROSTER OF REGISTERED ARCHITECTS, ENGINEERS, AND LAND SURVEYERS, 1958. Minnesota, Board of Registration for Architects, Engineers, and Land Surveyors. St. Paul, 1958. 71 pp.

PROCEEDINGS OF THE SECOND ANNUAL SURVEYING AND MAPPING CONFERENCE. Compiled and edited by Clifford G. Bryner. *Bulletin of the University of Utah*, Vol. 49, No. 15, May 1958. (Bulletin No. 90 of the Utah Engineering Experiment Station, Department of Civil Engineering.)

INTRODUCTORY GRAPHICS. J. Norman Arnold. *McGraw-Hill Book Company*, New York, 1958. 534 pp., illus., tables and graphs. $7.75. (Includes elementary treatment of map projection.)

SURVEYING; ELEMENTARY AND ADVANCED. W. H. Rayner and Milton O. Schmidt. *D. Van Nostrand Company, Inc.*, Princeton, New Jersey, 1957. viii and 916 pp., 567 figs., 31 tables. $8.50.

SURVEY ADJUSTMENTS AND LEAST SQUARES. Hume F. Rainsford. *Constable & Co.*, London. ix and 326 pp., tables, diagrams. 50s.

INSTRUCTION TECHNIQUE SUR LE NIVELLEMENT BAROMETRIQUE AU CONGO BELGE. L. Jones. *Academie Royale des Sciences Techniques*, Classe des Sciences Techniques, Memoires in-8°, Nouvelle Serie. Tome VII, fasc. 4 et dernier. Bruxelles, 1958. 65 pp., illus., tables, graphs.

(ARKANSAS) ROSTER OF REGISTERED PROFESSIONAL ENGINEERS, 1958, Board of Registration for Professional Engineers. Little Rock, 1958, 65 pp.

—LYMAN D. LYNN

Coast and Geodetic Survey

DISTINCTIVE RECENT MAPS

Maps of Canada, most of them published by the Dominion's Department of Mines and Technical Surveys [Ottawa], dominate this group of selections.

Mineral Map of the Province of Canada is a 1957 publication of that Department. The price listed on the map is one dollar. In addition to locating minerals the map outlines Pre-Cambrian and Mesozoic and Paleozoic formations, and shows railroads, main roads, pipe lines, and other cultural data. The scale is 1:1,267,200 and the size is 56 by 49 inches. There are enlarged insets of eight of the major mining areas and three small scale insets of Ontario showing Metallurgical Works, Natural Gas and Oil Fields, and Offices of the Department of Mines.

Uranium In Canada, published in 1958, is designated as a "Metallogenic Map." It is at the scale of 1:7,603,200 and measures 30 by 35 inches. "The main purpose of this map is to show the location of known uranium occurrences in Canada and to permit relating this information to principal geological features; in other words to illustrate the present state of knowledge of 'metallogenic provinces' for uranium in this country." Localities are listed on the map margin and keyed, by number, to map locations. Other marginal data include a list of 43 references, the legend, and "Explanatory Notes."

Map 1062A, in the cartographical series of the Department of Mines and Technical Surveys [Ottawa] is a *Geological Map of Southwestern Ontario Showing Oil And Natural Gas Producing Areas.* It is at a scale of 1:380,160 and measures 43 by 39 inches. Seventeen formations, ranging from Ordovician to Mississippian, are mapped. The may was compiled by B. V. Sanford who, along with J. F. Caley, and E. W. Best, also supplied the geological data on which it is based.

Principal Coal, Iron Ore, and Iron and Steel Areas in Relation to the St. Lawrence Seaway, are located in the eastern part of Canada and the United States on a map jointly published by the Geological Survey of Canada, and the Mines Branch, of the Department of Mines and Technical Surveys. Main sea routes and distances between port cities are also shown. The map measures 17 by 14 inches and is at the approximate scale of 1:11,600,000.

The Geological Survey, in the Department of Mines and Technical Surveys is also the publisher of new editions of two maps showing oil and gas fields and oil and gas discoveries (information to December 31, 1956). *Alberta and Northwestern British Columbia* is Map 1039A in the Survey's series and *Saskatchewan and Western Manitoba* is number 1044A. Both are at the scale of 1:1,267,200.

Canada Natural Resources locates and delimits the mineral, fisheries, power, agricultural, and forest riches of our northern neighbor. It was published in 1958 by the Department of Mines and Technical Surveys, Surveys and Mapping Branch. The price per sheet is 25 cents. The map measures 30 by 41 inches and is at the scale of 1:6,336,000.

The Royal Bank of Canada (409 8th Avenue West, Calgary, Alberta) issued in 1958 a *Canadian Oil and Gas Map*. Prepared by McDaniel Well Maps, Calgary, the map shows oil and gas fields, potential producing areas, existing and

proposed pipe lines and refineries. It measures 24 by 42 inches and is at the scale of 1:28,000,000. There are enlarged insets of Southeast Saskatchewan and the Edmonton Area.

The United States The Land and The People is a colorful pictorial map prepared for distribution at the Brussells Exhibition. Areas of scenic, historic, or economic interest are identified by appropriate pictographs. A brief description "About the United States" is printed next to the map. On the verso, is "A Guide to the United States Pavillion," with accompanying notes in English, Dutch, and French. The map was prepared by Mary Rossin.

Jeppeson & Company of Denver, Colorado, published in 1958 a new *Physical-Political Map of the United States*, at the scale of 50 miles to an inch. Relief is indicated by the skilled blending of color and shading in the artistic style perfected by Hal Shelton. Cities and towns, political boundaries, railroads, and major highways are also shown on the map, which measures 50 by 60 inches.

Chester B. Price is the compiler of a map showing *Historic Indian Trails* which was published in 1958 by the New Hampshire Archaeological Society. It is at the approximate scale of 1:5,200,000 and measures 22 by 13 inches. Ancient Indian villages, trading posts, Indian and English forts, missions, and camping places are shown.

Four interesting and informative maps of New York State were copyrighted in 1958 by Frank E. Richards of Phoenix, New York. All are at the scale of 1:1,600,000 and measure 16 by 20 inches. They are titled respectively *New York in the War for Independence 1775–1776, Indian Settlement in New York State, New York State Mean Annual Precipitation in Inches,* and *New York State Streamflow*. The first two were prepared by R. J. Raybach, the third is credited to C. P. Patton, and the last was prepared by E. E. Hanlon. All four were drawn by J. A. Peterson.

A 1:500,000 scale *Map of Mississippi Showing Oil and Gas Fields, Unsuccessful Test Wells, Salt Domes, and Pipelines* has been compiled by Helen M. Beickman and Sophie Drakoulis. It was published in 1958 by the U.S. Geological Survey, and is sold by that agency at 75 cents per copy. The map measures 45 by 40 inches. An inset map, at the scale of 1:250,000, shows oil and gas fields, unsuccessful test wells, and pipelines, for Adams, Wilkinson, and parts of Amite, Franklin, and Jefferson Counties.

The U.S. Geological Survey, in cooperation with the Nebraska Geological Survey, published in 1958 a *Map of Nebraska Showing Areal Distribution of Pre-Pennsylvanian Rocks, Anticlines and Basins, Oil and Gas Fields, Pipelines, and Unsuccessful Test Wells*. The map, which is at the scale of 1:500,000, was compiled by E. C. Reed and R. F. Svoboda of the Nebraska Geological Survey, and G. E. Prichard and Jeannette Fox of the U.S.G.S. This large map (33 × 60 inches) is available, at $1.00 per copy, from the U.S. Geological Survey. A table on the map sheet lists and locates "Oil and Gas Fields in Banner, Cheyenne, and Kimball Counties."

Argentina's Dirrección Nacional de Mineria [Buenos Aires] published in 1957 a *Mapa Minero de la Republica Argentina*. The map at the scale of 1:4,500,000, is accompanied by a small booklet which locates various mineral regions by provinces. Measurements of this colored map are 36 by 19 inches.

Richesses Minerales de la France locates the mineral resources of that republic. It is a recent publication of Editions Geographiques de France, 121 Boulevard St. Michel, Paris. The map measures 45 by 38 inches and is at the scale of 1:1,000,000. There are enlarged inset maps of the Lorraine iron basin and the coal basin "Du Nord et du Pas-de-Calais."

A noteworthy contribution to the cartography of the Middle East is a new contour map of the *Arabian Peninsula* prepared by the U.S. Geological Survey and the Arabian American Oil Company under the joint sponsorship of the Kingdom of Saudi Arabia, Ministry of Finance and National Economy, and the U.S. Department of State. It is at the scale of 1:2,000,000 and measures 48 by 53 inches. Lines of communication, oil fields, pipe lines and terminals, and various other cultural and natural features are mapped. The legend includes a glossary giving Arabic and English equivalents for various features.

A Pictorial Map of Japan, by Naigai Chizu Co., Ltd., graphically locates Japan's natural and agricultural resources and industrial centers. "Facts about Japan" are presented in a box at the base of the map sheet. The scale of the map is 1:3,000,000 and the dimensions are 28 by 20 inches.

Morac, Carte Economique, 1958, gives the current economic picture of Morocco. It is at the scale of 1:1,500,000 and measures 23 by 29 inches. The publisher is Institut Geographique National of Rabat, Morocco. Mineral, agricultural, and industrial resources, as well as communication systems are shown.

Sketch-map Showing the Geology of Borneo is a 1957 publication of the Geological Survey Department, British Territories in Borneo. It is at the scale of 1:2,000,000 and measures approximately 30 by 25 inches. Seven different igneous rock formations are indicated as well as nine sedimentary formations ranging in age from Devonian to Quarternary. "This map records,

and in many places interprets information collected by many geologists; particular reference has been made to accounts and maps published by Professor R. W. van Bemmelen. . . . The geology is described in the 1957 departmental report."

A *Geological Map of New Zealand*, at the scale of 1:2,000,000, was published in 1958 by the Department of Scientific and Industrial Research, New Zealand Geological Survey, Wellington, N. Z. A wide variety of formations, extending from pre-Cambrian to Quaternary are shown on the map, which measures approximately 34 by 24 inches.

Coastal Landforms of the World are identified and located on a map compiled by John T. McGill under contract between the Office of Naval Research and the University of California. The map, which is on the Briesemeister elliptical equal-area projection at the scale of 1:25,000,000, was prepared for publication by the American Geographical Society. It was issued as a supplement to the July 1958 issue of the *Geographical Review*, which also includes Mr. McGill's article about the map and its compilation. "Selected Shore Features Associated With Major Coastal Landforms" and "Major Coastal Landforms" are shown on the map. "The map of coastal landforms . . . should help to provide a realistic and rational basis for an improved system of coastal classification [and] . . . should prove useful as a guide to the general geomorphologic conditions to be encountered in landward sequence on any given coast from the offshore zone through the coastal strip."

It appears to be only a matter of time until man will reach the moon. If and when he does, he will have to guide him a *Map of the Moon*, published by Rand McNally and Company in July, 1958. "Based on photographs to assure complete accuracy, the map gives a comprehensive picture of the moon's surface as seen from the earth, showing and naming all important craters, mountains, oceans, and valleys." Three side panels show enlarged sections of some of the major feaures of the moon. Full-color drawings of the Jupiter and Vanguard and the first American satellites are also marginal illustrations. On the verso is a map of the planets showing their size and distance relationships as well as information and diagrams illustrating the diameters of the planets and the sun, eclipses, tides, and seasons, the earth and its atmosphere, and Halley's Comet.

WALTER W. RISTOW

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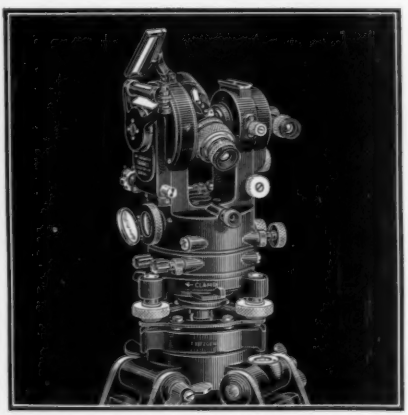

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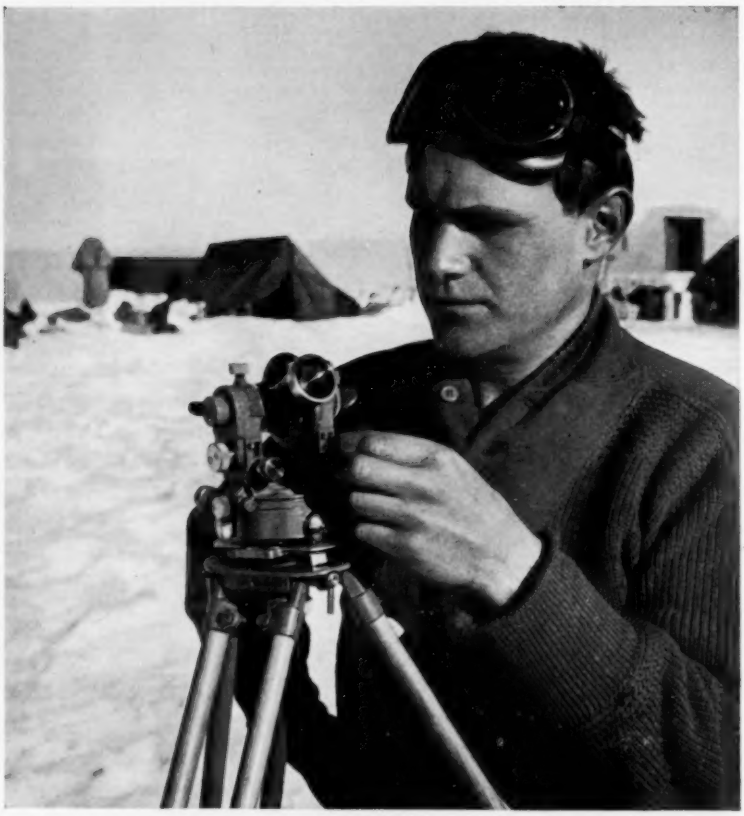

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The Surveyor and the Law

Dear Mr. Brown:

Will you comment on how to apply proration and on when proration is applicable and when it is not?

(Signed) E. L. M.

The definition of proration is simple; the difficulty is in knowing when to apply it. Below are a number of principles with brief explanations. It must be understood that any principle is merely a rule of construction or presumption that is subordinate to senior rights and subordinate to the intentions of the parties. Proportionate measurement is a means of distributing any surplus or deficiency that exists between related, found monuments or related, established points.

Definition of proportionate measurement.

"A proportionate measurement is one that gives concordant relation between all parts of the line, i.e., the new values given to the several parts, as determined by the remeasurement, shall bear the same relation to the record lengths as the new measurement of the whole line bears to that record." (Section 364, *Manual of Surveying Instructions,* Bureau of Land Management, 1947.)

In the above definition, "of the line" infers a line run by the *same surveyor* or a line resulting from the same map or plat, or from simultaneous conveyances. When locating a lot within a subdivision and applying this principle of proration, proration does not extend beyond the boundaries of that subdivision.

Proration does not apply where senior rights exist.

If a person has conveyed part of his property to another, he cannot at a later date convey it to someone else. The first deed gets all that is coming to it and the seller owns *all of the remainder.* If a person owns a remainder, no excess or deficiency exists. A remainder does not have a definite size; it is more or less in character. A person may have more or less land than he expects, but, so long as he has a remainder, the unexpected quantity of land, be it large or small, is all his. It is not divided among several owners.

The key to understanding when proration is applicable and when it is not are the words "time" and "creation." If parcels are *created* in sequence with a lapse of *time* between them, senior rights exist, and proration does not apply. For example, if Brown sells a parcel to Jones and at a later time sells another to Smith, Jones has senior rights over either Smith or Brown's remainder. Smith is senior to Brown (the seller must deliver all that he has sold, hence the seller is junior to the buyer), but junior to Jones. Brown is junior to both Smith and Jones. Where such junior and senior deeds exist, any measurement that differs from the record measurement is applied to the particular property to which it is applicable, and this is usually determined by senior rights. It it not divided among all the properties.

But what about subdivision maps where lots are sold in sequence and proration is applied? The word "created" is the key to the difference. Metes and bounds descriptions are usually *created* with a lapse of *time* between each creation and hence are *created in sequence.* Lots in a subdivision map are all *created* at the same *moment of time* (when the map is filed or accepted) even though the lots are sold in sequence. Lots created simultaneously cannot have one lot with greater rights than another, hence senior rights do not exist because no *lapse of time* exists between *creation of parcels.*

Sometimes measurement index is mistaken for proration. If a survey is called for in a particular metes and bounds description and it is discovered that the original surveyor used a chain which was consistently long or short, in order to follow the footsteps of the original surveyor a consistently long or short chain is used. This is not an adjustment between several ownerships or lots, but is an adjustment that applies to one ownership. Strictly speaking this is not proration, but is an application of the index-error principle.

Proration is applied whenever the intent of the original owner indicates that he created several parcels simultaneously with equal rights and there is no one parcel designated to receive a remainder.

Simultaneous descriptions are as follows:

(1) Wills and gifts wherein none of the

heirs or benefactors are designated to receive a remainder.

(2) Lots in subdivisions wherein a map is filed with a governing body and no lots are sold prior to filing the map or prior to staking.

(3) Lots in any subdivision wherein it is impossible to distinguish an intent to give senior rights to buyers in sequence.

(4) Court proceedings in partition wherein each litigant is given a proportionate share of the whole, and no one is designated to receive the remainder.

(5) Metes and bounds descriptions that are created simultaneously, and no one is designated to receive a remaider.

To illustrate when proration is applied, the following hypothetical situations are used.

Mr. Smith decides that he is going to sell several parcels of land in accordance with the wishes of the buyers. The first buyer takes the east 60 feet; the second buyer takes the west 50 feet; the third buyer takes the 80 feet immediately west of the first buyer, and the fourth buyer takes the remainder. With the fourth sale Mr. Smith files a map (under old laws any map was filed by presentation of filing fees, and in some areas this is still done) showing all four of the parcels with lot numbers. In this case there has been a *creation of parcels in sequence;* hence, proration does not apply and senior rights exist in spite of the fact that there is a filed map.

Again, Mr. Smith decides to sell off parcels of land, has a plat prepared, proceeds to sell parcels in accordance with the plat, and gives each buyer a copy of the plat. In most states this procedure is now illegal (plats must be filed with a governing body), but in the past this was commonly done. In this instance proration applies, since each lot was created prior to the sale of any one lot and since the map was a consideration of each sale.

Again, Mr. Smith decides to sell off parcels of land and has a plat prepared. He then conveys each parcel by a metes and bounds description without any reference to the plat, although the parcels agree in size and shape with the plat. Proration does not apply since the buyers have no knowledge of the map nor is the map mentioned as a consideration of the deed. Each parcel has a described perimeter that cannot be construed to be a proportional part of a map. Even if the seller intended each lot to be a proportional part of a map, the buyer could not be held to the secret intentions of the seller; the intentions must be in writing.

Again Mr. Smith decides that he will sell several parcels, has a map prepared, files the map with a governing agency, and sells lots by lot and block numbers. Proration applies since a person buying one lot is buying a proportionate part of a block and there is no way of distinguishing a senior intent or a remainder.

Mr. Smith decides to give each of his three friends one-third of his land. He has metes and bounds descriptions prepared (perimeter descriptions) that gives each an equal amount. He presents all three deeds at substantially the same time. If a deficiency or surplus is discovered, each is entitled to a share, since the intent was to create three parcels of equal size. Proration applies.

But there are certain rules about proration that limit its application.

Proration is not applied beyond an undisturbed original monument that is considered as part of the deeds.

Where there is a survey called for and the original surveyor marks the position of lots, the lots are unchangeable except by resubdivision or proof of fraud. Proration is not used to alter the original location of the original lots but is used to prorate discrepancies found to exist *between* original monuments.

Proration is not used to distribute an error that can be proved to exist in one place.

Proration is for the purpose of disposing of discrepancies, the location of which cannot be fixed. It presupposes the idea that each owner has an equal right to any surplus or deficiency. Where an error is proved to exist in one place, the presumption that each owner has equal rights is overcome and the error is placed where it occurs.

Proration, as a means of distributing discrepancies, is a rule of last resort.

Only when the idea of equal rights to land is conveyed, is proration applied. If it is possible to distinguish a person with prior rights, proration is not used. Proration may be used to re-establish a lost corner, but only after every means has been exhausted to determine the actual original location of the corner. The courts have gone so far as to state that in many instances old, existing fences and lines of occupancy are better evidence of where the original lines were located than is proration or measurements from distant points. If fences show where the original lines were located, proration cannot be used to alter the original lines. Thus, only after other considerations have been

eliminated, is proration applied. It is a rule of last resort used to distribute *unaccountable* discrepancies.

Proration cannot alter rights obtained by unwritten means.

If land is gained by occupancy, agreement, or other unwritten means, proration cannot alter these rights. The old lines are extinguished and new title lines exist.

Proration is applied to proportional conveyances under State laws, but not always under Federal sectionalized land law.

A proportional conveyance, such as the North half of Lot 12, receives a proportionate part of the whole area by common law. For sectionalized land Federal Statute law defines proportional conveyances (North ½ of the NW ¼ of Section 7) in such a manner that a proportional part of the area is *not* conveyed.

These are my ideas on the subject, as based upon my reading. Perhaps some of you disagree or would like to add to the above by sending your comments to the editor.

—CURTIS M. BROWN

EDITOR'S NOTE.—Further explanation is given in Mr. Brown's recent book, "Boundary Control and Legal Principles." (Reviewed, SURVEYING AND MAPPING, October–December 1957, Vol. XVII, No. 4, pages 435–436.)

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C. and G. Survey Chart 541 Modernized

The 35th edition of nautical chart 541, covering New York Harbor's Upper Bay and Narrows, was published late in 1957. This chart, which has been completely modernized, now offers coverage which includes all of Gowanus Bay on Brooklyn's waterfront, the Jersey City waterfront, Staten Island south to Fort Wadsworth, and the Battery at the tip of Manhattan. In the modernization process many of the soundings were eliminated and depth curves are shown by solid black lines at depths of 6, 12, 18, 30, 36, and 60 feet. As a result of these changes the chart now presents an uncongested picture of the water's depth and the bottom configuration throughout the harbor.

Probably one of the most noticeable changes, which will not only be of value to the mariner but also to the entire shipping industry in the New York area, is the almost unrestricted use of topographic detail along the waterfront. The street pattern, as well as rail and warehouse facilities, are shown in a manner that has never been attempted on this chart since its first edition in 1898.

Other interesting additions to the chart are the installations, now shown in outline, on Governors Island, Ellis Island and, last but not least, the most famous landmark in the area—the Statue of Liberty on Liberty Island. Incidentally, the name of the island, which was formerly Bedloes Island, was changed by an Act of Congress in 1956.

As in previous editions the anchorages are indicated. In fact, they are in such profusion there in the world's busiest port that this chart is the only one, out of more than 800 charts published by the Coast and Geodetic Survey, that is designated an anchorage chart.

Chart 541 was compiled from hydrographic and topographic surveys of the Coast and Geodetic Survey, with revisions and additions from other sources. All lights, beacons, buoys, and dangers to navigation have been corrected for information received to the date of issue.

The chart is at a scale of 1: 10,000. Copies may be obtained from sales agents, district offices, and the Washington office of the Survey. The price is $1.00 per copy.

Surveying and Mapping Conference

The Third Annual Surveying and Mapping Conference, sponsored by the Utah Chapter of the American Public Works Association in cooperation with the Civil Engineering Department of the University of Utah, was scheduled for December 11–12, 1958, on the University of Utah Campus, Salt Lake City, Utah. "Activities of ACSM" by an officer of the Utah Section of ACSM, and a paper on "Industrial Measuring Problems" by L. C. Higbee, a former president of the American Congress on Surveying and Mapping, were included in the two-day program with sessions on land surveying, mapping, and general topics; with a display of technical equipment and materials.

Books in Review

ELLIPSOIDISCHE PARAMETER DER ERDFIGUR, 1800–1950 (Spheroidal Parameters of the Figure of the Earth from 1800–1950) George Strasser. Deutsche Geodätische Kommission bei der Bayerischen Akademie der Wissenschaften, Reihe A: Höhere Geodesie, Heft Nr. 19, 113 pages, München 1957 (German).

Dr. Strasser's work is essentially a compilation of all determinations of the Figure of the Earth, in chronological order from 1718 to 1953, quoting the pertinent publication for each set of values. Since also an account of the material and method used in each determination is given with each listing, the paper amounts to a concise history of geodetic thought and effort. The introduction presents the connected historical development and a discussion of the various units of length measurements. Numerical relations between them and the international meter are given, as are the details of the various national standards. There are convenient summaries in the form of tables and graphs. A list of references at the end supplements the documentations of the individual items. To assist the English reader the table of contents, the introduction, and the table of abbreviations are repeated in English.

Dr. Strasser's study is a most valuable addition to every geodetic library.

IRENE FISCHER

Army Map Service

PROCEEDINGS OF THE FOURTH NATIONAL SURVEYING TEACHERS CONFERENCE—AUGUST 4 to 9, 1957. x + 165 pages. 1958.

The Fourth National Surveying Teachers Conference was held at Camp F. W. Welch, the State College of Washington camp, at Naches, Washington, from August 4 to 9, 1957, under the sponsorship of "Committee VIII–Surveying and Mapping" of the American Society for Engineering Education and the Civil Engineering Department of the State College of Washington. The proceedings of this conference were published in 1958 by the Technical Extension Services of the State College of Washington.

This paper covered, illustrated publication, with a page size of approximately 8½ by 11 inches, contains the program of the conference, a roster of those attending the conference, the eighteen formal papers presented during the conference, resolutions and reports, and an author index.

This publication contains a wealth of interesting and informative reading of interest to anyone concerned even remotely with surveying as a part of engineering education.

Copies may be obtained from D. H. Harkness, Secretary, Committee VIII, c/o W. & L. E. Gurley, 514 Fulton St., Troy, N. Y., at $2.00 per copy, postage paid.

HOWARD S. RAPPLEYE

HISTORY OF MATHEMATICS. David Eugene Smith. *Dover Publications, Inc.* New York, 1958. Vol. I, xxii + 596 pages, Vol. II, xii + 725 pages. $2.75 per volume.

This two-volume work is "an unaltered and unabridged republication of the last edition," presumably the one copyrighted in 1953 by Eva May Luse Smith, the first edition having been copyrighted by David Eugene Smith in 1925.

The book was written with the avowed purpose ". . . of supplying teachers and students with a usable textbook on the history of the elementary mathematics, that is, of mathematics through the first steps in the calculus."

The writer, being unacquainted with this work prior to receiving a review copy of the 1958 publication, was mildly astounded in working through it to see the enormous amount of material involved; the copious notes which document statements in the text and lead the reader to even more detailed source material; the many excellent illustrations; and to find that even though written in textbook style these volumes make mighty interesting reading.

Coverage of the subject is, of course, worldwide, and from prehistoric times up to about the middle of the 19th century.

It is the writer's humble opinion that Dover Publications, Inc., has done a distinct service to all who read the English language in bringing out this relatively inexpensive, paper covered, edition of this so exhaustive and yet so readable work.

HOWARD S. RAPPLEYE

MAP INFORMATION

This department was inaugurated for the purpose of bringing to the attention of the members information pertaining to the availability of maps, surveys, etc., with particular emphasis on how such material can be procured. It is believed that through an interchange and dissemination of such information maximum benefits will accrue to the surveying and mapping profession.

—EDITOR

Topographic Maps

THE FOLLOWING quadrangle maps were published or became available for distribution by the U. S. Geological Survey between June 1 and August 31, 1958. The list includes newly compiled maps; revised maps on which contours and drainage usually are unchanged but the works of man are brought up to date; and series-converted maps which are 15-minute maps produced from four 7½-minute maps of the same area. The maps are new unless otherwise designated by numerical superscript.

The quadrangle name (in capital letters) is followed by the name of the county (in upper- and lower-case letters) that contains the place or feature for which the quadrangle is named.

All maps are available with or without the green overprint that indicates woodland. These maps show the shape and elevation of the land surface (represented by contour lines, printed in brown—except those marked with the letter (P), which are planimetric); water features (in blue); works of man, including cities, towns, and scattered habitations, schools, churches, railroads, roads and boundaries, place and feature names (in black); and woodland areas (in green). Principal roads are shown by a red overprint. In areas that have been covered by Bureau of Land Management surveys, township and section lines are shown. The State rectangular coordinate and the UTM 1,000-meter grid systems are indicated in the margins of the maps. An information folder further describing topographic maps is available on request.

Standard quadrangle maps may be obtained for 30 cents per copy. A discount of 20 percent is allowed on orders amounting to $10 or more at the retail price; a discount of 40 percent is allowed on orders amounting to $60 or more. Orders should be addressed to the U. S. Geological Survey, Washington 25, D. C., (or Denver 15, Colo., for maps of areas west of the Mississippi River).

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* Indicates 15-minute quadrangles; all others are 7½-minute quadrangles.
[1] Indicates a revised map.
[2] Indicates a series-converted map.
† Indicates availability in either a contour or a shaded-relief edition.
‡ Indicates preliminary black and white edition.

Alabama

BARTON—Colbert
BENTON*—Lowndes
BLACKBURN—Lauderdale
CHEROKEE—Colbert
FLORENCE—Lauderdale
FRANKFORT—Franklin
OLD BETHEL—Colbert
PLEASANT GROVE—Frankl'n
PRUITTON—Lauderdale
RUSSELLVILLE—Franklin
SINKING CREEK—Lauderdale
THREET—Lauderdale
WRIGHT—Lauderdale

Alabama-Mississippi

WATERLOO—Lauderdale

Alaska

CRAIG (A-2)*—First Judicial Division
FORT YUKON (C-2)*—Fourth Judicial Division
FORT YUKON (C-4)*—Fourth Judicial Division
GULKANA (D-1)*—Third Judicial Division
GULKANA (D-2)*—Third Judicial Division
IDITAROD (D-1)*—Fourth Judicial Division
KATEEL RIVER (B-5)*—Fourth Judicial Division
MEDFRA (A-5)*—Fourth Judicial Division
MEDFRA (A-6)*—Fourth Judicial Division
MELOZITNA (D-2)*—Fourth Judicial Division
MT. Hayes (A-1)*—Fourth Judicial Division
MT. HAYES (C-3)*—Fourth Judicial Division

MT. HAYES (D-2)*—Fourth Judicial Division
MT. MCKINLEY (C-2)*—Fourth Judicial Division
MT. MCKINLEY (D-1)*—Fourth Judicial Division
MT. MCKINLEY (D-3)*—Fourth Judicial Division
NULATO (A-6)*—Fourth Judicial Division
OPHIR (A-2)*—Fourth Judicial Division
PETERSBURG (D-6)*—First Judicial Division
PORT ALEXANDER (A-3)*—First Judicial Division
PORT ALEXANDER (B-2)*—First Judicial Division
PORT ALEXANDER (D-1)*—First Judicial Division
SKAGWAY (C-3)*—First Judicial Division
SKAGWAY (C-4)*—First Judicial Division

Arizona

AVONDALE SE—Maricopa
PERRYVILLE—Maricopa
REDINGTON*[1]—Pima
RUBY*[1]—Santa Cruz
SABINO CANYON—Pima
TOLLESON—Maricopa
TUBAC*[1]—Santa Cruz
TUCSON EAST—Pima
WHITE TANK MTS. SE—Maricopa

Arkansas

CLARENDON*—Monroe
DE VALLS BLUFF*—Prairie
HOLLY GROVE*—Monroe
MARIANNA*—Lee

Arkansas-Louisiana

EUDORA*—Chicot

California

BRAWLEY—Imperial
CALEXICO—Imperial
CARRIZO MTN. NE—Imperial
CHESTER*—Plumas
COYOTE WELLS—Imperial
DALE LAKE*—San Bernardino
DANBY*—San Bernardino
EL CENTRO—Imperial
FRAZIER VALLEY—Tulare
FRINK*—Imperial
JOAQUIN ROCKS*[1]—Fresno
KERENS*—San Bernardino
LEEK SPRING HILL*[2]—El Dorado
LOVEJOY BUTTES—Los Angeles
MT. HARKNESS*—Plumas
MOUNT SAN ANTONIO—Los Angeles
MOUNT SIGNAL—Imperial
PLASTER CITY—Imperial
QUIEN SABE*[1]—Bealto
ROBBS PEAK*[2]—El Dorado
SEELEY—Imperial
SHASTA DAM—Shasta
SPRINGVILLE—Tulare
TASSAJARA HOT SPRINGS—Monterey
VENTANA CONES—Monterey

Colorado

AXIAL*[1]—Moffat
BUFFALO PEAK—Jackson
CEDAR 3 NW—Dolores
‡CEDAR 3 SW—Montezuma
‡CORTEZ SW—Montezuma
DERBY[1]—Adams
ENGLEWOOD[1]—Arapahoe
FITZSIMONS[1]—Adams
FORT LOGAN[1]—Arapahoe
GOLDEN—Jefferson
JACK CREEK RANCH—Jackson
JOHNNY MOOR MOUNTAIN—Jackson
LITTLETON[1]—Arapahoe
‡MOQUI NW—Montezuma
‡MOQUI SE—Montezuma
‡MOQUI SW—Montezuma
PARKVIEW MOUNTAIN—Grand
RABBIT EARS PEAK—Jackson
RAND—Jackson
‡SENTINEL PEAK NE—Montezuma
‡SENTINEL PEAK NW—Montezuma
SPICER PEAK—Jackson
SPINNEY MOUNTAIN—Park
STORM MOUNTAIN—Routt
WALTON PEAK—Routt
WESTCREEK—Douglas
WHITELEY PEAK—Grand

Connecticut

CORNWALL[1]—Litchfield (1:31,680)
ELLSWORTH[1]—Litchfield

Florida

ARCADIA—De Soto
EL JOBEAN—Charlotte
ENGLEWOOD—Sarasota
ENGLEWOOD NW—Sarasota
GILCHRIST—Charlotte
LONG ISLAND MARSH NE—De Soto
LONG ISLAND MARSH NW—De Soto
LONG ISLAND MARSH SE—De Soto
PLACIDA—Charlotte
PUNTA GORDA—Charlotte
PUNTA GORDA SW—Charlotte
VENUS—Highlands

Georgia-Florida

BADEN—Brooks
BEACHTON—Grady

Illinois

KENNEY*—De Witt
MAROA*—Macon

Indiana

AZALIA—Bartholomew
BUTLERVILLE—Jennings
CAMPBELLSBURG—Washington
EPSOM[1]—Daviess
LIVONIA—Washington
PARAGON—Morgan
PLAINVILLE[1]—Daviess
WASHINGTON[1]—Daviess

Indiana-Illinois

FAIRBANKS[1]—Sullivan
MEROM[1]—Sullivan

Iowa

AGENCY—Wapello
NEOLA—Pottawattamie
OTTUMWA SOUTH—Wapello
OTTUMWA SOUTH*—Wapello
TAYLOR—Pottawattamie

Kansas

ANTIOCH—Miami
BLACK WOLF[1]—Ellsworth
BROOKVILLE SW—Ellsworth
CARNEIRO—Ellsworth
DORRANCE—Russell
DORRANCE SW—Russell
ELBING—Butler
ELLINWOOD—Barton
ELLINWOOD SW—Barton
ELLSWORTH—Ellsworth
ELMDALE—Chase
EMPORIA—Lyon
FLORENCE—Marion
GARDNER—Johnson
HOLYROOD NE—Ellsworth
LANG—Lyon
LEBO—Coffey
LEBO NW—Coffey
LINCOLNVILLE SW—Marion
LOUISBURG—Miami
NEWTON—Harvey
PAOLA EAST—Miami
SAFFORDSVILLE—Chase
SPRING HILL—Johnson
STRONG CITY—Chase
VENANGO—Ellsworth
WAVERLY—Coffey
WAVERLY NW—Coffey
WESTFALL SE—Ellsworth
WESTFALL SW—Ellsworth
WILLIAMSBURG—Franklin
WILSON—Ellsworth
WONSEVU—Chase

Kentucky

CHURCH HILL[1]—Christian
HOPKINSVILLE[1]—Christian
KELLY[1]—Christian

Louisiana

ALEXANDRIA—Rapides
BRETON ISLAND—Plaquemines
CARENCRO*—Lafayette
COLUMBIA*—Caldwell
FREEMASON ISLAND—St. Bernard
GRAND GOSIER ISLAND—Plaquemines
LAKE DECADE*[2]—Terrebonne
MANGHAM*—Richland
MANSFIELD*[1]—De Soto
MANY*[1]—Sabine
MOSS BLUFF*[2]—Calcasieu
NEW HARBOR ISLAND—St. Bernard
NORTH ISLANDS—St. Bernard
OPELOUSAS*—St. Landry
PLEASANT HILL*[1]—Sabine
POINT AU FER*[2]—Terrebonne
STAKE ISLAND—St. Bernard
TOPSY—Jefferson Davis
VIVIAN*[1]—Caddo
WEST MONROE SOUTH—Ouachita

Louisiana-Mississippi

CHANDELEUR LIGHT—St. Bernard

Louisiana-Texas

TORO—Sabine
ZWOLLE*—Sabine

Maine

BIDDEFORD[1]—York
NORTH BERWICK[1]—York
OLD ORCHARD BEACH[1]—York
PORTLAND EAST[1]—Cumberland
SKOWHEGAN*—Somerset
YORK HARBOR[1]—York

Maryland

PHOENIX[1]—Baltimore

Maryland-Virginia

ROCKVILLE—Montgomery

Massachusetts

BOSTON NORTH[1]—Suffolk

Michigan

BAIE DE FASAI—Chippewa
BRIMLEY—Chippewa
BRIMLEY*[2]—Chippewa
FIFE LAKE*—Grand Traverse
KINGSLEY*—Grand Traverse
LAKE GEORGE*[2]—Chippewa
OAK RIDGE—Chippewa
PAYMENT—Chippewa
SAULT STE MARIE*[2]—Chippewa
SAULT STE MARIE SOUTH—Chippewa
SHALLOWS—Chippewa
SHELLDRAKE*[2]—Chippewa
STRONGS*[2]—Chippewa

Minnesota

KING LAKE—St. Louis
PEQUAYWAN LAKE—St. Louis

Minnesota-Wisconsin-Iowa

BROWNSVILLE*—Houston

Mississippi

DEER ISLAND—Harrison
DOG KEYS PASS—Jackson
ENTERPRISE*—Clarke
GULFPORT NORTH—Harrison

IUKA—Tishomingo
SHIP ISLAND—Harrison

Mississippi-Alabama-Tennessee
YELLOW CREEK—Tishomingo

Mississippi-Louisiana
CAT ISLAND—Harrison

Missouri
BOGARD—Carroll
HARDIN—Ray
KNOXVILLE—Ray
LAWSON—Ray
MILLVILLE—Ray
NORBORNE—Carroll
RAYVILLE—Ray
RICHMOND—Ray
ROADS—Carroll
STET—Ray

Montana
CASTAGNE—Carbon
ROBERTS—Carbon
ROSCOE NE—Carbon
SILESIA—Carbon

Nebraska-Kansas
BEAVER CITY SE—Furnas
BEAVER CITY SW—Furnas
LEBANON—Redwillow
PRECEPT—Furnas
WILSONVILLE—Furnas

Nevada
BELTED PEAK*—Nye
BLACK MTN.*—Nye
CACTUS SPRING*—Nye
DAYTON*—Lyon
GOLDFIELD*—Esmeralda
GROOM MINE*—Lincoln
LOVELOCK*—Pershing
MELLAN*—Nye
QUARTZITE MTN.*—Nye
SILENT CANYON*—Nye
WHEELBARROW PEAK*—Nye
WHITE BLOTCH SPRINGS*—Nye

New Hampshire
CARDIGAN*[1]—Grafton

New Jersey
ROSELLE[1]—Union
TOMS RIVER—Ocean

New Jersey-New York
JERSEY CITY—Hudson
PERTH AMBOY[1]—Middlesex
YONKERS—Westchester

New Mexico
BOULDER LAKE*—Rio Arriba
MESA APAREJO*—Valencia
MOUNTAINAIR*—Torrance
SOUTH GARCIA*—Valencia

New York
BELLPORT—Suffolk
BIGELOW—St. Lawrence
BUFFALO*[2]—Erie
EAST HAMPTON—Suffolk
EASTPORT—Suffolk
MATTITUCK—Suffolk
MEXICO—Oswego
OWEGO—Tioga
RIVERHEAD—Suffolk
WALDEN[1]—Orange

New York-Vermont
PLATTSBURGH*[1]—Clinton
ROUSES POINT*[1]—Clinton

North Carolina
ASHFORD—McDowell
CHESTNUT MTN.—Burke
LINVILLE FALLS—Burke
MORGANTOWN SOUTH—Burke
MURCHISONTOWN—Hartnett

Ohio-West Virginia
PARKERSBURG—Wood

Oklahoma
BRUNO—Atoka
BUTLER*—Custer
COALGATE—Coal
COALGATE SE—Coal
CORDELL*—Washita
DILL CITY*—Washita
FARRIS—Atoka
LANE—Atoka
LANE NE—Atoka
LANE NW—Atoka
LEHIGH—Coal
LEONARD—Tulsa
LIMESTONE GAP—Atoka
STRINGTOWN—Atoka

Oregon
BLUE RIVER*—Lane
CANNON BEACH*—Clatsop
CAPE FOULWEATHER*[1]—Lincoln
CARLTON—Yamhill
CHUCKSNEY MTN.*—Lane
EUCHRE MTN.*[1]—Lincoln
FOREST GROVE—Washington
GERVAIS—Marion
GOODWIN PEAK*[1]—Lane
HARL BUTTE*—Wallowa
HECATA HEAD*—Lane
LAURELWOOD—Washington
MISSION BOTTOM—Marion
OAKRIDGE*—Lane
REEDSPORT*—Douglas
ST. PAUL*—Marion
VALSETZ*[1]—Polk
YAQUINA*[1]—Lincoln

Oregon-Idaho
KERNAN POINT*—Wallowa

Pennsylvania
HUMMELSTOWN*[1]—Dauphin

Pennsylvania-New Jersey
BANGOR[1]—Northampton

Puerto Rico
RIO GRANDE[1]—Rio Grande

Rhode Island
PRUDENCE ISLAND[1]—Newport

South Carolina
FOUNTAIN INN*—Lawrence
WILLIAMSTON*—Anderson

South Dakota
MOUNT RUSHMORE*[2]—Pennington
PRINGLE—Custer
PRINGLE*[2]—Custer

Tennessee
ASHLAND CITY—Cheatham
BILLINGSLEY GAP[1]—Bledsoe
BURNS—Dickson
CHEATHAM DAM—Dickson
COLLEGE GROVE—Williamson
GARDNER—Weakley
MELVINE—Bledsoe
MORGAN SPRINGS—Rhea
NOAH—Coffee
PIKEVILLE—Bledsoe
ROCKVALE—Rutherford
RUSKIN—Dickson
SANGO—Montgomery
SMYRNA—Rutherford
STANTON*[2]—Haywood
VANDEVER—Cumberland

Tennessee-Virginia
WHEELER—Lee

Texas
AMMANNSVILLE—Fayette
CAPLEN[1]—Galveston
EL JARDIN—Willacy
FLAKE[1]—Galveston
LA GRANGE EAST—Fayette
LAKE COMO[1]—Galveston
LA PALOMA—Galveston
LA SAL VIEJA—Willacy
LASARA—Willacy
NORIAS—Kenedy
PORT BOLIVAR[1]—Galveston
RIO HONDO—Cameron
ROSITA LAKE—Kenedy
ROSITA LAKE NE—Kenedy
SAN PERLITA NORTH—Willacy
SAN PERLITA SOUTH—Willacy
TEXAS CITY[1]—Galveston
THE JETTIES[1]—Galveston
VIRGINIA POINT[1]—Galveston
WACO WEST—McLennan
WALL*—Tom Green
WICHITA FALLS EAST*—Wichita
WICHITA FALLS WEST*—Wichita
WICHITA FALLS WEST[1]—Wichita
YTURRIA—Willacy

Texas-Oklahoma
BURKBURNETT*—Wichita

Utah
‡ANETH 1 NW—San Juan
FIDDLER BUTTE—Garfield
‡VERDURE 2 NE—San Juan
‡VERDURE 2 NW—San Juan
‡VERDURE 2 SW—San Juan

Utah-Colorado
‡ANETH 1 NE—San Juan
‡VERDURE 4 NE—San Juan
‡VERDURE 4 SE—San Juan

Virginia
ANNANDALE—Fairfax
BOWERS HILL[1]—Princess Anne
CAPE HENRY[1]—Princess Anne
HAMPTON[1]—Hampton
HARRIS GROVE[1]—York
KEMPSVILLE[1]—Princess Anne
LITTLETON[1]—Sussex
MANRY[1]—Southampton
MESSICK[1]—York
MORRISON[1]—Warwick
NEWPORT NEWS[1]—Newport News
NORFOLK NORTH[1]—Norfolk
NORFOLK SOUTH[1]—Norfolk
OCEAN VIEW[1]—Princess Anne
PRINCESS ANNE[1]—Princess Anne
SAVEDGE[1]—Surry
SEBRELL[1]—Southampton
VIRGINIA BEACH[1]—Princess Anne
WAVERLY[1]—Sussex

Virginia-D. C.-Maryland
ALEXANDRIA—Alexandria

Virginia-Maryland
VIENNA[1]—Fairfax

Washington
BOW—Skagit
COUGAR*—Cowlitz
EPHRATA*—Grant
GRANITE FALLS*—Snohomish
GREENWATER*—King
OLYMPIA*[1]—Thurston
OHOP VALLEY*[1]—Pierce
OSO*—Snohomish
TENINO*[1]—Thurston
WILKESON—Pierce
WILSON CREEK*—Grant
YACOLT*—Clark
YELM*[1]—Thurston

West Virginia
KANAWHA—Wood

West Virginia-Ohio
WHEELING—Ohio

Wisconsin
MILLADORE* (P)—Wood
STEVENS POINT* (P)—Portage
WEYAUWEGA* (P)—Waupaca

Wyoming
ADAM WEISS PEAK—Hot Springs
DUNDEE MEADOWS—Fremont
EMERALD LAKE—Fremont
ESMOND PARK—Fremont
MILK CREEK—Hot Springs
RAMSHORN PEAK—Fremont
RIVERTON NE¼—Fremont
SNOW LAKE—Fremont
SOAPY DALE PEAK—Park
WARM SPRING MOUNTAIN—Fremont

In addition to the standard series of quadrangle maps, small-scale (1:250,000) maps of areas in the United States and Territories are being published and distributed. They may be purchased from the Geological Survey for 50 cents per copy. An index to the series is available on request.

Alaska
BLACK†
CAPE MENDENHALL†
KOTZEBUE†
NAKNEK†
NULATO†
ST. MATTHEW†
SHUNGNAK†
TABLE MOUNTAIN†
UNIMAK

Alabama-Georgia
PHENIX CITY

Arizona-U. S.-Mexico
AJO

California
SANTA MARIA

Georgia-Alabama
ATLANTA

Idaho-Montana-Wyoming
ASHTON

Idaho-Wyoming
DRIGGS
PRESTON

Iowa-Minnesota
MASON City

Maine
BATH

Michigan-Ontario, Canada
SAULT STE MARIE

Minnesota-Iowa
FAIRMONT

Montana
CHOTEAU
DILLON
FORSYTH
GLASGOW
GREAT FALLS
HAVRE
JORDAN
ROUNDUP

Montana-North Dakota
GLENDIVE
MILES CITY
WOLF POINT

Montana-North Dakota-South Dakota
EKALAKA

Montana-Wyoming
BILLINGS
HARDIN

North Dakota
BISMARCK
McCLUSKEY

Nebraska-Iowa
FREMONT
OMAHA

Nebraska-Kansas
LINCOLN

New Mexico-Texas
LAS CRUCES

South Dakota
MARTIN

South Dakota-North Dakota
McINTOSH

Utah
CEDAR CITY
DELTA
RICHFIELD

Utah-Idaho
BRIGHAM CITY

Washington-Idaho
PULLMAN

Washington-Idaho-Montana
SPOKANE

Wisconsin-Michigan
MILWAUKEE

Wyoming
ARMINTO
CASPER
CODY
THERMOPOLIS

Wyoming-Colorado
ROCK SPRINGS

Wyoming-Colorado-Nebraska
CHEYENNE

Wyoming-Montana
SHERIDAN

Wyoming-Montana-South Dakota
GILLETTE

United States-Canada
SHELBY

Special metropolitan-area and vicinity maps of major United States cities are being published and distributed by the Geological Survey. These maps are prepared from standard 7½-minute maps at the scale of 1:24,000. Vicinity maps may be purchased from the Geological Survey for the prices indicated below.

PHILADELPHIA AND VICINITY (Pennsylvania-New Jersey) 2 sheets (44 by 72 inches, each sheet) $1.50 each, $3 per set.

State maps are also being published and distributed. These maps may be purchased from the Geological Survey for the prices indicated below.

#KENTUCKY (base map). (15 by 30 inches) 1 : 1,000,000 scale. 20¢.
NORTH CAROLINA (relief). (29 by 67 inches) 1 : 500,000 scale. $2.

# Indicates that map does not show contours.

Lake Survey Charts

PUBLICATION of new editions of the following Lake Survey Charts has been announced by the United States Lake Survey of the Corps of Engineers, U. S. Army. Copies of these charts may be obtained from the U. S. Lake Survey, 630 Federal Building, Detroit 26, Mich., at 75 cents per copy. Payment is required in advance by P. O. money order or draft, payable to the Treasurer of the United States. A catalog showing the areas described below is available free upon request.

9.—Lake Superior. General chart of the entire lake at 1 : 500,000 scale. (June 1958)
11.—St. Lawrence River. St. Regis, Que., to Croil Islands, N. Y., at 1 : 30,000 scale. (June 1958)
12.—St. Lawrence River. Croil Islands to Leishman Pt., N. Y., at 1 :30,000 scale. (June 1958)
13.—St. Lawrence River. Leishman Pt. to Ogdensburg, N. Y., at 1 : 30,000 scale. (June 1958)
17.—St. Lawrence River. Bartlett Point Light, N. Y., and St. Lawrence Island, Ont., to Cape Vincent, N. Y., and Cold Bath Shoal, Ont., at 1 : 30,000 scale. Inset : Cape Vincent, N. Y., at 1 : 10,000 scale. (April 1958)
52.—Coast chart. Pte. aux Barques, Mich., to 11 miles north of Oscoda, Mich., including Saginaw Bay at 1 : 120,000 scale. Insets : Tawas Harbor, Mich., at 1 : 30,000 scale. Entrance to Au Sable River, Mich., at 1 : 10,000 scale. (June 1958)
935.—Marquette and Presque Isle Harbors, Mich., at 1 : 15,000 scale. (June 1958)
943.—Keweenaw Bay, Mich., at 1 : 30,000 scale. Insets : L'Anse, Mich., at 1 :10,000 scale. Pequaming, Mich., at 1 : 10,000 scale. (July 1958)
964.—Ashland and Washburn Harbors, Wis., at 1 : 15,000 scale. (July 1958)
966.—Duluth-Superior Harbor at 1 : 15,000 scale. (May 1958)

Public Land Survey Plats

THE FOLLOWING plats of public land surveys and resurveys were completed and accepted by the Bureau of Land Management between June 1 and August 31, 1958. The class or purpose of the survey is indicated. Copies of plats may be secured from the Bureau offices in the States or from the Director, Bureau of Land Management, Department of the Interior, Washington 25, D. C.

Alaska

U. S. Survey No. 3396—Small Tracts–Mountain Point
U. S. Survey No. 3397—Small Tracts–Herring Bay
U. S. Survey No. 3441—Small Tracts–Manley Hot Springs
U. S. Survey No. 3453—Townsite of Birch Lake
U. S. Survey No. 3458—N. Addition No. 7, Achorage Townsite
U. S. Survey No. 3482—Small Tracts–North Sitka Highway
U. S. Survey No. 3531—Small Tracts–Snug Harbor
U. S. Survey No. 3540—Public Service Site, Clover Passage
U. S. Survey No. 3554—Kotzebue Municipal Airport

Alaska—Fairbanks Meridian

T. 2 S., R. 3 E.—Survey, part of subdivision

California—San Bernardino Meridian

T. 3 N., R. 1 E.—Dependent resurvey
T. 16 N., R. 9 E.—Skeleton survey
T. 16 N., R. 10 E.—Skeleton survey
T. 17 N., R. 9 E.—Skeleton survey
T. 17 N., R. 10 E.—Skeleton survey
T. 17 N., R. 11 E.—Skeleton survey
T. 18 N., R. 10 E.—Skeleton survey
T. 18 N., R. 11 E.—Skeleton survey
T. 18 N., R. 12 E.—Skeleton survey
T. 18 N., R. 12½ E.—Skeleton survey
T. 18½ N., R. 12 E.—Skeleton survey
T. 19 N., R. 12½ E.—Skeleton survey
T. 19 N., R. 9 E.—Skeleton survey
T. 19 N., R. 10 E.—Skeleton survey
T. 19 N., R. 11 E.—Skeleton survey
T. 20 N., R. 9 E.—Skeleton survey
T. 20 N., R. 10 E.—Skeleton survey
T. 20 N., R. 11 E.—Skeleton survey
T. 20½ N., R. 9 E.—Skeleton survey
T. 20½ N., R. 10 E.—Skeleton survey
T. 20½ N., R. 11 E.—Skeleton survey
T. 2 S., R. 23 E.—Dependent resurvey, part
T. 3 S., R. 23 E.—Dependent resurvey, part
T. 4 S., R. 23 E.—Dependent resurvey, part
T. 5 S., R. 23 E.—Dependent resurvey, part
T. 5 S., R. 24 E.—Dependent resurvey, part
T. 6 S., R. 23 E.—Dependent resurvey, part

Colorado—Sixth Principal Meridian

T. 5 S., R. 77 W.—Small tract surveys
T. 5 S., R. 78 W.—Small tract surveys
T. 9 S., R. 98 W.—Dependent resurvey
T. 10 S., R. 98 W.—Dependent resurvey
T. 17 S., R. 72 W.—Dependent resurvey

New Mexico Principal Meridian

T. 31½ N., R. 19 W.—Survey of subdivision
T. 33½ N., R. 20 W.—Survey of subdivision

Nevada—Mt. Diablo Meridian

T. 44 N., R. 37 E.

New Mexico—New Mexico Principal Meridian

T. 6 N., R. 7 W.—Survey, Acoma Purchase Area Boundary
T. 7 N., R. 6 W.—Dependent resurvey
T. 25 S., R. 11 W.—Dependent resurvey
T. 25 S., R. 12 W.—Dependent resurvey

Oregon—Willamette Meridian

T. 2 S., R. 9 W.—Dependent resurvey, part
T. 3 S., R. 7 W.—Dependent resurvey, part
T. 25 S., R. 1 W.—Dependent resurvey, part
T. 29 S., R. 7 W.—Dependent resurvey, part

South Dakota—Black Hills Meridian

T. 5 N., R. 5 E.—Dependent resurvey and survey
T. 6 N., R. 5 E.—Dependent resurvey and survey

Utah—Salt Lake Meridian

T. 36 S., R. 20 E.—Skeleton surveys
T. 37 S., R. 17 E.—Skeleton surveys
T. 37 S., R. 18 E.—Skeleton surveys
T. 37 S., R. 19 E.—Skeleton surveys
T. 37 S., R. 20 E.—Skeleton surveys
T. 38 S., R. 17 E.—Skeleton surveys

T. 38 S., R. 18 E.—Skeleton surveys
T. 38 S., R. 19 E.—Skeleton surveys
T. 38 S., R. 20 E.—Skeleton surveys
T. 39 S., R. 17 E.—Skeleton surveys
T. 39 S., R. 20 E.—Skeleton surveys
T. 43 S., R. 2 E.—(4) Small tracts–Glen Canyon

Wyoming—Sixth Principal Meridian

T. 20 N., R. 86 W.—Dependent resurvey
T. 28 N., R. 71 W.—Dependent resurvey and subdivisional
T. 30 N., R. 100 W.—Dependent resurvey, part
T. 43 N., R. 60 W.—Dependent resurvey

Coast and Geodetic Survey Charts

THE FOLLOWING new or basically changed nautical and aeronautical charts were issued by the Coast and Geodetic Survey during the second quarter of 1958. Copies may be secured from Bureau offices and authorized agents in the United States and possessions, or from the Director, Coast and Geodetic Survey, Washington 25, D. C. Remittances covering cost should be made payable to Coast and Geodetic Survey, Department of Commerce. Complete catalogs of both nautical and aeronautical charts are issued free upon request.

Nautical

4001—Hawaii to French Frigate Shoals, Hawaiian Archipelago. General chart to which Loran lines of position for the new rate 2L7 have been added. Former Loran rates 2L4 and 2L6 have been designated 2L6 and 2L4 respectively; at scale of 1:1,650,000 (June, 1958) $1.00.

4111—Nawiliwili Bay, Kauai, Hawaiian Islands. Harbor chart showing extensive shoaling in certain areas as disclosed by recent surveys; at scale of 1:50,000 (July, 1958) 50 cents.

4134—Kaneohe Bay, Oahu, Hawaiian Islands. New harbor chart showing detail of entire bay and harbor area; at scale of 1:15,000 (May, 1958) $1.00.

6156—

6157—Columbia River–Vancouver to The Dalles, Oreg. & Wash. Harbor chart of river and channel, showing realignment of the main channel south of Reed Island from Gary Island to Onion Rock; at scale of 1:40,000 (July, 1958) 75 cents.

Aeronautical

Albuquerque. Sectional chart on completely reconstructed base; at scale of 1:500,000 (June, 1958) 25 cents.

Dayton. Local chart with new limits; at scale of 1:250,000 (April, 1958) 25 cents.

Huntington. Sectional chart completely reconstructed with many changes; at scale of 1:500,000 (May, 1958) 25 cents.

Miami. Sectional chart completely reconstructed; at scale of 1:500,000 (June, 1958) 25 cents.

Washington. Sectional chart reconstructed; at scale of 1:500,000 (March, 1958) 25 cents.

Same for Third Quarter of 1958

Nautical

5532—San Francisco Entrance, Calif. Completely reconstructed harbor chart on the Mercator projection, with limits extended to include all of Oakland Inner Harbor. The chart has been modernized to conform to present standards and is based on modern surveys by the Coast and Geodetic Survey and the Corps of Engineers, together with recent aerial photography and Geological Survey topographic quadrangles; at scale of 1:40,000 (September 1958) $1.00.

5574—Carquinez Strait, Calif. Harbor chart of entire narrows between Suisun and San Pablo Bays, showing revised hydrographic information and additional shoreline detail, including the extension of channel limits on the south side of Suisun Bay; at scale of 1:10,000 (July 1958) $1.00.

Aeronautical

Sectional charts at a scale of 1:500,000 on completely reconstructed bases, as follows:

Boise (September 1958) 25 cents
Norfolk (July 1958) 25 cents
Orlando (August 1958) 25 cents
San Antonio (July 1958) 25 cents

Right-of-way Award to Frank C. Balfour

Frank C. Balfour, Chief Right-of-way Agent of the California Division of Highways, was presented tribute for public service before some 500 or more right-of-way leaders from all parts of the U.S.A., at a national seminar in San Francisco this summer, by the American Right of Way Association, which is a nationwide professional organization of right-of-way men. The resolution commended Balfour for "leading the cause of professionalism of right-of-way practices and procedures throughout the United States." This was the Association's first award to a member of the profession for dedication to public service in its 24-year history.

The professional approach of right-of-way men, and the professional approach of highway engineers, should be marching in the same objective direction with professional approach to geometronic engineering—the science of professional surveys—the basic physical science of route and property-line surveys. The professional aspect of right-of-way is important to professional aspects of control surveys and property surveys and perpetuation of "survey markers" or perpetuation of the survey value therefrom by careful transfer of marks to safe places when faced with damage or destruction by highway construction.

WALTER S. DIX
Executive Secretary, ACSM

Comment and Discussion

The pages of SURVEYING AND MAPPING are open to a free and temperate discussion of all matters pertaining to the interests of the CONGRESS. It is the purpose of this Department to encourage comments and published material or the presentation of new ideas in an informal way.
—EDITOR

D. R. G. WAGER-SMITH*—A few weeks ago I became a member of the American Congress on Surveying and Mapping, and have received several recent issues of the Journal, including the January–March, 1958 issue.

Please accept my congratulations on a very fine publication. Format, type, makeup, and content are excellent. I regard it as a valuable addition to the several engineering magazines that I receive.

May I make a suggestion? Frequently in reading an article the reader finds passages about which he would like to communicate directly with the author. I believe that communications of this sort are valuable to the publication, to the profession, and to the author who has worked hard on his article; and that, therefore, all reasonable means should be employed to facilitate direct communication between authors and readers. Pursuant to these ideas, I suggest that the author's mailing address be included in the by-line. A good example is ASCE's *Civil Engineering*.

* 531 Hermosa Drive, Northeast, Albuquerque, N. Mex.

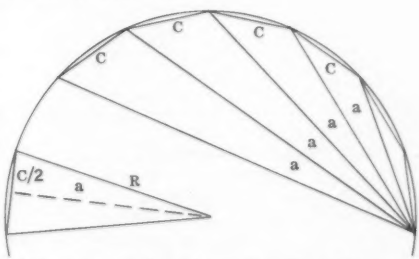
EDITOR'S NOTE.—Thanks for the suggestion. We will see what we can work out.

CIRCULAR CURVES AGAIN

R. D. COMSTOCK*—To find the radius of an existing curve, measure off a number of equal chords and turn the angles (a). The angle (a) can be obtained by dividing the total angle by the number of chords. The angle (a) will equal half the central angle for the chord chosen. The radius may be computed by the sine equation, or by using the cosecant, and

$$R = (C/2)\ (\text{cosec}\ a)$$

This is useful especially on railroads and highways, where a considerable length of curve can be seen from one setup. The angle (a) becomes half the degree of curvature, by the railroad formula, if the measured chords are 100 feet in length.



We once saw in a Lancaster, Pa., restaurant, the walls of which were plentifully decorated with cards bearing Pennsylvania Dutch sayings, a sign which read, "When the little red house is by, the train is all." Apparently the caboose on this train of thought regarding the radii of circular curves is still nowhere in sight.
—EDITOR

* Registered Civil Engineer, 1601 East Gonzalez St., Pensacola, Fla.

HOW LONG A CHORD?

LEGARE HAMILTON*—In the course of laying out a subdivision recently, I had occasion to wonder just how long a chord I might use on the short radius curves and hold to the error allowable in this case. No book in my library gave the information wanted. All said that shorter chords are used for short radius curves, but none gave any figures related to degree of accuracy. So I worked out the accompanying table in which D equals the degree of curvature and R equals the radius. All are shown as 100-foot chords, but column 6 expresses the chord as percent of the radius. Column 7

* Civil Engineer-Land Surveyor, Georgetown, S. C.

shows the number of parts in which there would be one part error.

The values in Column 6 were then plotted against those in Column 7. These gave the curve shown. From this curve I found that if I were working to an allowable error of 1 in 5,000 the curve must be laid out with chords no more than 7 percent as long as the radius. If I allowed myself an error of 1 in 3,000, chords as long as 9 percent of the radius might be used, as shown by the dotted lines.

The relationship of error to chord-as-percent-of-radius is constant and may be used on curves of any radius.

(1) DEGREE OF CURVE	(2) RADIUS (*From Trautwine*)	(3) CHORD $2R \sin \frac{D}{2}$	(4) ARC = $\frac{DR}{180}$ = .0174533 *DR*	(5) DIFFERENCE (*Arc Minus Chord*)	(6) $\frac{100 \text{ CHORD}}{\text{RADIUS}}$	(7) $\frac{100}{\text{DIFFERENCE}}$
1°	5729.648	100	100.0013	.0013	1.75	76,923
2°	2864.934	100	100.0051	.0051	3.49	19,608
3°	1910.077	100	100.0114	.0114	5.24	8,772
4°	1432.685	100	100.0203	.0203	6.98	4,926
5°	1146.279	100	100.0318	.0318	8.72	3,145
6°	955.366	100	100.0457	.0457	10.47	2,188
7°	819.020	100	100.0622	.0622	12.21	1,608
8°	716.779	100	100.0813	.0813	13.95	1,230
9°	637.275	100	100.1030	.1030	15.69	971
10°	573.686	100	100.1271	.1271	17.43	787

(Curve is on opposite page)

B. S. in Cartography

"Want a Degree in Cartography?"

This headline appeared in several District of Columbia newspapers before the fall semester started. This unusual "eye catching" title line came about in response to continued requests from many Government Agencies which have cartographic missions. A number of local educational institutions took up this challenge and have come forth with an outstanding cartographic program so sorely needed in this field of edcuation.

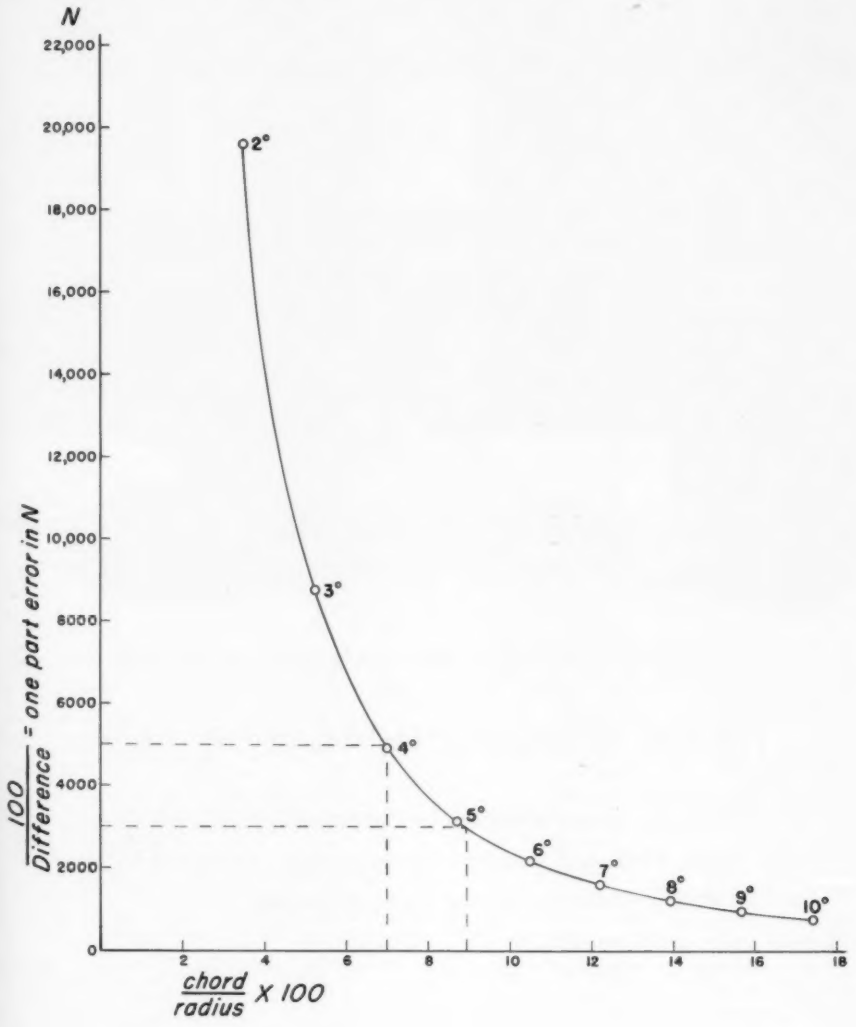
The George Washington University is one of the first universities in the United States announcing a program leading to the degree of Bachelor of Science in Cartography. The curriculum is designed to present a sound educational program which meets the educational requirements of the professional cartographer. Cartographic subjects constitute the major field of study; Engineering, Geography, and Mathematics are supporting subjects.

Although other institutions of learning in the Washington area do not offer a complete course leading to a degree in cartography, yet the subjects offered are of such nature as to meet the professional qualifications required by various Government cartographic agencies.

The U. S. Department of Agriculture Graduate School is one of those institutions and offers courses in Geodetic Surveying, Theory of Geodesy, Mathematics for Cartographers, and Large Scale Maps.

Georgetown University also offers various courses in geodesy.

Lately a number of European institutions have been offering cartographic courses and it is hoped that additional United States educational institutions will soon plan to sponsor a cartographic program similar to that given in the Washington area. This should be all the more so because of the advent of the recently enacted educational legislation by the Federal Government. (Public Law 85-507)



Geodesists Needed

The United States Civil Service Commission —in Announcement No. 168 B, Issued September 23, 1958, no closing date—announces an examination for Geodesists, GS grades 5 to 15, at $4,040 to $12,770 a year. Anyone interested in this unassembled examination should write to the U. S. Civil Service Commission, Washington 25, D. C., for information concerning positions to be filled, and how to apply. Applicants are rated on their training and experience as evidenced by Form 57 and supporting papers, after proper verification.

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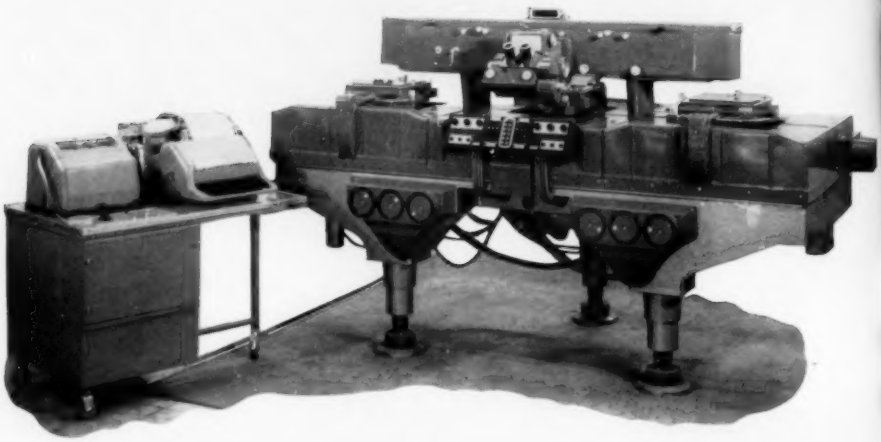

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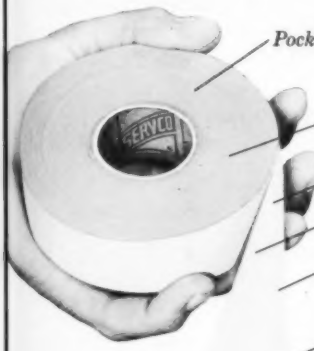

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Abstracts of Articles on Geodesy and Related Fields

The Army Map Service, of the Corps of Engineers, U. S. Army, publishes quarterly a series of processed sheets under the title: "Abstracts of Articles on Geodesy and Related Fields." The following are excerpts from the issue bearing the date July 1958 and are selected for reprinting in SURVEYING AND MAPPING as being of possible interest to a considerable percentage of our readers. The selection has been somewhat arbitrary, and only those abstracts believed to be of quite general interest have been included.—EDITOR.

403 *Geodesy, a Science of Observations* (La Géodésie, Science d'observations). Pierre Tardi

There is a tendency to classify all sciences into the following two categories: Theoretic sciences and Experimental sciences. But there are some sciences which cannot be put in either one of these two groups. Such is the case of Geodesy, Astronomy and several other sciences.

Therefore, geodesy should be called the science of observations. Various geodetic fields were examined and explained in order to support the theory that geodesy is the science of observations.

FESTSCHRIFT C. F. BAESCHLIN (French)-AMS-GL-B644.9002 (1957)-ma

412 *Sun-Altitude Azimuths* (Uber Sonnenhoehenazimute). F. Toepfer

The most important methods of determining an astronomic azimuth during field operations are the observations of polaris and the sun. The first method is more accurate, the second more economical. Sun azimuths are recommended for all work which does not require an accuracy of more than $\pm 10''$. A simple target such as the sun circle and approximate recording of meteorological conditions suffice for this degree of accuracy. This report shows that the observations of sun azimuths fulfill their purpose even if no thermometer and barometer are available. Therefore, the only auxiliary equipment needed for these observations are a sun circle for the theodolite, a high angle prism protected from the glare of the sun and a watch which is accurate within one to three minutes. For the evaluation of the observations an astronomic yearbook will also be required.

The Zeiss 030 theodolite has proven particularly suited to these observations.

The test measurements have confirmed the theoretical results. If observations are limited to the times when $da/dh = 2.2$, and $h = 15°$, an internal and external accuracy of $\pm 10''$ is attained in the proposed simple procedure.

VERMESSUNGSTECHNIK, (German)-AMS-GL-B664.7350, v. 5 No. 9 (1957)-ms

413 *The Measurement of 1st and 2nd Order Eccentricities With the Zeiss, Jena 2 m. Subtense Bar* (Zur Messung von Exzentrizitaeten I. and II. Ordnung mit der 2 m-Basislatte vom VEB Carl Zeiss JENA). C. Bernatzky.

Eccentricities exceeding 50 m. have been measured so far nearly exclusively with the measuring rod. New developments have made it possible to devise new methods using the 2 m. Subtense bar (called Bala for short in this article) for the determination of eccentricities between 50 and 200 m. The author limits himself to these distances, because measuring tapes give faster and sufficiently accurate results for eccentricities of less than 50 m.; and 200 m. is generally accepted as the maximum for eccentricities.

Three sources of errors are then given for parallactic precise distance measurement: accidental (such as errors in the angle observation); systematic (such as errors in the adjustment of the Bala) which, however, must not be taken into consideration when computing the mean error, but must be added to the accidental errors and, thirdly, errors which result from admissible tolerances in, e.g., the construction of the equipment; these latter can be eliminated by corrections and do not have to be taken into consideration.

The various errors are then discussed in detail, then the combined effect of accidental and systematic errors on the usual arrangement of measurements. Next, the determination of the error limit is given for parallactic angle observation. Finally, the error limits for parallactic precise distance measurement.

This article is well supported by pertinent tables.

VERMESSUNGSTECHNIK, (German)-AMS-GL-B664.7350, No. 11 (1957)-ms

416 *Study of the Usability of Combination Towers in Higher Order Triangulations* (Untersuchungen ueber die Brauchbarkeit des kombinierten Signaltyps fuer Triangulationen hoeherer Ordnung). W. Lorenz

First, the regular tower is described which has two separate non-touching structures; one for the signal and the observer and one for the instrument stand. Then the combination tower now widely used in the Soviet Union when the height of the observer is more than 12 m. The instrument stand forms an integral part of the tower; its supports are connected to the tower at a height of 6 to 8 m. above the ground, but the two structures do not touch any other place. The great economic advantage of this type of tower is that it saves up to 40% in material and wages.

One regular and one combination type tower were built for purposes of comparing their suitability to higher order triangulation work. The horizontal shifts of the instrument table and the tip of the pyramid and the rotation of the point at which the instrument was placed around a vertical axis were studied for several months. The report gives all this information in great detail.

It is concluded that the regular and combination type towers are equal with regard to horizontal shift and rotation. However, the combination type is much more subject to the influence of wind, which makes it unsuitable at present for 1st order observations. It is, nevertheless, considered as the most suitable signal for lower order triangulations in view of its combination of economy and technical adequacy.

Vermessungstechnik, (German)-AMS-GL-B644.7350, v. 5 No. 9 (1957)-ms

419 *A Penta-mirror as an Optical Micrometer.* (Der Pentaspiegel als optisches Mikrometer.) N. Barany

The paper deals with optical micrometers, especially the Boskovich rotating pair of wdeges, known for about 200 years. The author has designed the pentamicrometer by matching the rotating pair of wedges and the penta-mirror. It is pointed out that heat effects arising at the setting of the penta-mirror form the basis of the condition of functioning of the whole system. Comparison of the combination of the pair of wedges and of the penta-mirror with the plain rotating pair of wedges shows that the solution of incorporating the mirror eliminates image deviation occurring with the pair of wedges. On the other hand, the only disadvantage of the penta-micrometer, the magnitude of image shift caused by rotation, is a negligible quantity in surveying instruments.

The penta-micrometer is suggested in the first place for telemeters of geodetic tachymeters with short integral part of the instrument.

Acta Technica Scientiarum Hungaricae (German)-AMS-GL-910.1069, v. 13, No. 3–4 (1955)-af

421 *Fifty Years of Geodetic Activities of the Geodetic and Geophysics Institute of Padua University* (1907–1957) Cinquant'anni di attivita geodetica dell'Instituto di geodesia e geofisica dell'Universita di Padova (1907–1957). Dr. Armando Norinelli

The historical development of the Geodetic Institute, founded in 1907, is presented in detail.

In 1942, the Geodetic Institute changed its name to the Geodetic and Geophysics Institute. In the post-war period the Institute developed rapidly. Since 1949, the Institute's periodical "Nuova serie" is regularly published. Since 1950, large-scale gravimetric surveys are being carried out. At the end of 1956 there were determined 1,082 gravimetric and 368 magnetic stations. An important astro-geodetic survey along the Adriatic coast was carried out in 1956. In the meantime geophysical research was initiated.

A brief description of recently obtained and most modern instruments concludes the paper.

Rivista del Catasto e dei Servizi Tecnici Erariali (Italian)-AMS-HD671 R62, v. 12, No. 2 (1957)-am

425 *On an Analytic Experimental Law for Barometric Leveling* (Su di una legge analitico-sperimentale per le livellazioni barometriche). Prof. B. Bonifacino

The barometric leveling method was recently modernized by the introduction of microbarometric aneroids, specially designed by the Askania Company. The accuracy of the elevations determined with such instruments is greatly increased and meets the requirements for technical projects.

The Boaga corrections for barometric leveling are discussed in detail, mathematically proved and well illustrated with diagrams and tables.

Rivista del Catasto e dei Servizi Tecnici Erariali (Italian)-AMS-HD671 R62, v. 12, No. 2 (1957)-ma

431 *General Formulae for the Deflections of the Vertical and Laplace Azimuths* (Obshchiye formuly ukloneniya otvesnoy linii i azimuta Laplasa). A. A. Izotov

The author investigates the relationship between geodetic coordinates and astronomic determinations of position and azimuth, and the effect of errors in the latter determinations on the parallelism between the axis of the earth's revolution and the minor axis of the reference ellipsoid. The errors in astronomic latitude determination will displace the true zenith in the plane of the meridian, while errors in azimuth and longitude determination will also cause a displacement of the zenith in the plane of the prime vertical. The cumulative effect of these errors at individual astronomic points will be accidental. However, any error in astronomic determination of position and azimuth at the initial point of a triangulation system will have a systematic effect. In order, therefore, to secure parallelism between the axis of rotation and the minor axis of the reference ellipsoid, very precise astronomic determinations at the initial point are necessary.

Geodeziya i Kartografiya No. 6 (1957) AMS-GL-B 675.2214 (1957) No. 6-ap

432 *A Simultaneous Adjustment of Leveling Nets of Various Orders* (O sovmestnom uravnoveshivanii nivelirnykh setey razlichnykh klassov) V. P. Kozlov.

The author indicates that in order to reduce the effect of errors of the initial data it is necessary to carry out a simultaneous adjustment of the second, third, and fourth order level nets. For this purpose the author demonstrates that equivalent lines according to the following correlation are substituted for level lines of the second to fourth order.

$$L_{\text{2nd order}} = 4L_{\text{3rd order}} = 16L_{\text{4th order}}$$

A comparison of the results of this simultaneous adjustment of level lines of various orders which belong to the same loop and were previously separately adjusted, shows that the mean-square error of the junction bench marks has decreased by an average of 45 percent, in comparison with the errors obtained in separate adjustments. The time needed for this adjustment does not exceed the time spent on separate adjustments.

Trudy Miigaik (Russian)-AMS-GL-B675.-2299 No. 25 (1957)-ap

434 *On the Problem of Visibility in Geodetic Measurements* (Problem vidljivosti kod geodetiskih merenja). Dušan Benčić

The accuracy of measurement does not depend only on the precision of the instruments and on the capability of the observers, but on the atmospheric conditions as well. Generally speaking, the problem of visibility was not taken into consideration by geodetic writers. Even in Jordan's formulae this important factor of influence is missing.

The problem of visibility is analyzed in the following manner: (1) measurements with the greatest utilization of favorable visibility; (2) measurements without the greatest utilization of favorable visibility; (3) the human eye and its physiological qualities; (4) the telescope and its optical qualities; (5) the atmosphere; (6) the illumination and brightness of sighting points; (7) the night measurements.

Geodetski List (Serbian)-AMS-GL-B658.-7100, v. 11. Nos. 9/12 (1957)-ma

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Map on Magazine Cover

The *American Legion Magazine*, August 1958, has a very striking cover. The background for the whole cover is a reproduction of a section of a modern road map. The territory included extends from Manistique and Mackinaw City on the north to a little below the latitude of Centralia on the south, and from the Windsor-Detroit area on the east to the longitude of Platteville, Wisconsin, on the west. In the blue area for Lake Michigan, large letters call attention to the National Convention of the American Legion to be held in Chicago, September 1–4, 1958. Superimposed on the map, in addition to the title of the magazine, etc., is an array of airplanes, trains, buses, and private cars—all headed toward Chicago. The result is an eye-catching cover.

Within the magazine there is an interesting popular article on the history of road maps, "Keeping 'Em on the Road" by Jack B. Kemmerer, which is well illustrated and contains some rather startling facts which prove that "the free road map is big business."

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News of Related Organizations

Indiana Society of Professional Land Surveyors

The fall meeting of committees of the Indiana Society of Professional Land Surveyors was held at the Turkey Run State Park, November 7–8, 1958. This constituted a working session for the twelve committees of the organization. Attendance was not limited to committee members and any interested members could attend if they wished to do so.

President George Crowder attended the annual meeting of the American Congress on Surveying and Mapping, Washington, D.C., March 24–26, 1958. The two following paragraphs are quoted from his report to the I.S.P.L.S., as published in their *Surveying and Mapping Newsletter,* September 1958, Vol. IV, No. 3.

"Most of the meetings that I attended were staged by the Property Surveys Division. I was particularly impressed by the caliber of the men who participated in these programs and was inspired by their devotion to our profession and their concern for their fellow surveyors and the public. As long as we are being represented by such people as these, we will not go too far wrong."

"Much of the program concerned methods and problems beyond the scope of work normally done by the average surveyors; however, knowledge of these methods and problems is bound to make one better qualified to cooperate with our state and national agencies and support their views in what they are attempting to do."

Land Surveyors' Association of Washington

Newly elected officers of the Land Surveyors' Association of Washington, with term office from July 1, 1958, to June 30, 1959, are as follows:

Hugh Goldsmith, *President*
Wilfred Webb, *Vice President*
Robert Jones, *Secretary*
Lowell Palmerton, *Treasurer*

—Robert W. Jones
Secretary

Kansas Society of Land Surveyors

The Kansas Society of Land Surveyors met in their first annual convention on October 25, 1958, at the Jayhawk Hotel in Topeka, Kansas. The KSLS has been organized less than one year but already has four State Chapters—Kansas City, Topeka, Salina, and Wichita—with a total membership of 112, and a steady growth in membership is expected.

The following officers were elected for 1959, to take office immediately:

President—James L. Bell, Prairie Village
Vice President—Charles Pfarr, Topeka
Secretary—Wendell Wyatt, Salina
Director (3 years)—Grant A. Brezina, Dodge City

The principal concern at this convention was the report of the Legislative Committee and the interest in submitting a bill to the Kansas State Legislature to license surveyors. It is the intention of the Legislative Committee to submit such a bill in January 1959. It is hoped at this time that the bill can be submitted in conjunction with the Kansas Engineering Society and the Consultant's Section of the Kansas Engineering Society.

The newly-elected president, James L. Bell, presented a brief report on the "Final Report by the Task Committee on Status of Surveying and Mapping, Surveying and Mapping Division, American Society of Civil Engineers." Brother B. Austin Barry, Chairman of that committee, furnished a preliminary copy of the report, not yet approved by ASCE. The review was presented without comment or criticism from the

floor in order to avoid any preliminary criticism or comment prior to final action by ASCE.

A very successful day was ended with a banquet at which the principal speaker was State Senator James Porter of Topeka. He spoke on the subject of Legislation.

Following a petition authorized by unanimous approval in a meeting at Salina, Kans., July 30, 1957, the Kansas Society of Land Surveyors has duly qualified and is a newly affiliated institutional member of ACSM.

Missouri Association of Registered Land Surveyors

The Second Annual Meeting of the Missouri Association of Registered Land Surveyors was held at the Missouri School of Mines, Rolla, Mo., on October 4, 1958, with nearly 100 persons in attendance.

A tour of the Photogrammetric Section of the U. S. Geological Survey's office at Rolla was an outstanding feature of the program.

At the luncheon the speaker was James L. Bell, Chairman of ACSM's Property Surveys Division's committee on Fees and Salaries. Mr. Bell reviewed the background of ACSM, its accomplishments, and its aims, with special emphasis on those programs within the Property Surveys Division of special interest to the property surveyors present at the meeting.

Certain printed matter from ACSM was made available to those present. This included membership application blanks, copies of articles from SURVEYING AND MAPPING, and other information which would indicate the advantages of membership in ACSM. A direct invitation was given to all members of the MARLS to join ACSM, and it was explained that this was in no way competitive with their present affiliation with ASCE, but simply offered a national contact with other surveyors with specific interests the same as theirs and also offered the advantage of receiving the quarterly Journal.

Mr. Bell also reviewed the Fees and Salaries study. Five thousand questionnaires were sent out to surveyors throughout the United States. A great percentage of these were returned, and even more interest was evident than had been anticipated. Mr. Bell will discuss the results of this survey at the 19th Annual Meeting of ACSM in Washington next March.

State Senator Hatcher, who was instrumental in securing the passage of the Missouri Surveyors License Law, was present at this meeting and spoke on legislative matters.

Dean C. L. Wilson of the Missouri School of Mines and Metallurgy and his staff were present and were very helpful in making the Second Annual Meeting of the MARLS the success it was.

Officers elected for 1959 are as follows:

President—T. C. Horstman, Jefferson City
President Elect—C. C. Redman, Jr., Kennett
Vice President—R. P. Patient, Ferguson
Director (3 years)—Dewey Jett, Linn
Director (2 years)—G. W. Pritchard, Independence
Director (1 year)—G. H. Kastendieck, Springfield

The mailing address of this organization is: Missouri Association of Registered Land Surveyors, P. O. Box 355, Jefferson City, Mo.

California Council of Civil Engineers and Land Surveyors Adopt Convention Program

At its meeting in Sacramento on October 18th, 1958, the California Council of Civil Engineers and Land Surveyors, with their president, George C. Bestor, executive secretary, William A. White, and eighteen directors present, adopted a full and varied program proposed by F. William Pafford of Los Angeles. Milton E. Jeanney, who will be convention manager, announced that the Statler-Hilton Hotel in Los Angeles will be the headquarters for the convention to be held January 23–24, 1959.

A major feature of the convention program will be a report on the most extensive study ever undertaken in this country on the status of surveying and mapping.

Matters of consulting practice, education, public relations, organization, and legislative and technical affairs, were also reported. There was also informal discussion of the California highway program and associated survey practices of various governmental agencies and the private practices of the civil engineering and land surveying professions.

Association of Provincial Land Surveyors of Nova Scotia

A meeting of the Association of Provincial Land Surveyors of Nova Scotia was held at the Lord Nelson Hotel in Halifax October 27–28, 1958. ACSM's former president, Lester C. Higbee, presented greetings from the American Congress on Surveying and Mapping. This genial gentleman has frequently carried the good word of ACSM far and wide on many similar occasions and needs little, if any, introduction to either Canadian or United States members of ACSM.

New "Bowditch"

The popular AMERICAN PRACTICAL NAVIGATOR, commonly known as "Bowditch", after Dr. Nathaniel Bowditch, author of its first edition, has been completely rewritten at the U. S. Navy Hydrographic Office. The new 1524-page edition, available on or about December 6, 1958, the 128th birthday of the Hydrographic Office, may be obtained from sales agents of the Hydrographic Office or from the Superintendent of Documents and his sales agents, at $6.25 per copy.

"Bowditch," long considered the final authority on navigation throughout the world, was first published in 1802. In 1868 the Hydrographic Office purchased the copyright and plates. Of all the approximately 70 editions of the book, only one before the 1958 edition represented a thorough rewrite. This was the edition of 1882, prepared by Commander P. H. Cooper, USN. The 1958 edition was prepared by a team headed by Alton B. Moody.

The new "Bowditch" has been given a dark blue cover with gold lettering, to distinguish it from previous editions. Although completely rewritten, it retains the objective of the first edition, that of being a complete summary of practical navigation, with useful supplementary information, all presented in such manner that any mariner willing to apply himself can understand it without an instructor. He will be assisted by practice problems, at the ends of many chapters, and more than 500 illustrations, some in color. However, the book is condensed, being intended primarily as a reference book for navigators. In addition to the principles of routine navigation, it includes information of use when the unusual is encountered. An extensive, 68-page index makes the information easy to locate.

The book is divided into eight "Parts." The first deals with background information and fundamentals, the second with piloting and dead reckoning, the third with electronics and navigation, the fourth with celestial navigation, the fifth with the practice of navigation under various conditions, the sixth with oceanography in its various navigational aspects, the seventh with weather, and the eighth with the production of charts. Throughout, universal methods are given greater emphasis than those with special application, where a choice is available. The need for judgment based upon experience is stressed.

The eight Parts, of some 900 pages, are divided into 44 chapters. These are followed by 29 appendices containing a wealth of reference information of interest to navigators, and extracts from various government publications for which sample problems are given in the text.

Following the appendices are 34 tables, which, with their explanation, cover 272 pages. Although a number of these tables were carried over from previous editions, all tables have been carefully checked for accuracy, arrangement, and limits, and a number of changes have been made.

The paper on which the book was printed was carefully selected after tests of a number of samples. Consideration was given to strength, wearing qualities, effect of dampness, opacity, thickness, presentation of illlustrations, freedom from glare, and noncurling qualities. The cover, too, was selected for wearing qualities as well as for pleasing appearance.

The new "Bowditch" is a worthy successor of of the book which has so long been affectionately considered by many to be the "Sailor's Bible."

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Nautical Charts of the Harbors and Coasts

The Coast and Geodetic Survey publishes over 300 charts of the harbors and rivers of the continental United States, in addition to those of the territorial possessions. These charts are intended for navigation and anchorage relatively close to shore, in protected waters. Their scales range from 1: 2,500 to 1: 50,000 depending on the size and importance of the waterway and the number and kinds of dangers existing. They depict in detail the natural and dredged channels with their controlling dimensions. Prominently charted are the dangers and limiting lines of defined anchorage, restricted and prohibited areas, and the aids to navigation which mark these features. Port facilities are indicated by proper designation. In general, topography of areas visible from the water, or extending inland to the principal highway paralleling the shoreline, is delineated. Prices are 25 cents, 50 cents, 75 cents and one dollar, depending on the size of the chart.

Coast charts, on the other hand, are published at scales of 1: 50,000 to 1: 100,000. They are intended for close coastwise navigation when a vessel's course carries her inside outlying reefs and shoals, for use in entering rivers and harbors of considerable size, and for use in navigating the larger bays and sounds. Visual aids to navigation are shown in all cases except in very restricted waterways where they appear on larger scale charts. In addition, the charts covering Massachusetts Bay and the entrances to New York Harbor, Delaware Bay, and Chesapeake Bay contain Loran lines for electronic position determination. The Coast Chart series covers the entire Atlantic and Gulf coasts and the Puget Sound Area in the continental United States, and numerous areas in the territories. Along the west coast and in the other areas not covered by charts of this class, vessels customarily follow a course well offshore and use the smaller scale General Charts which are also designed for navigation with the aid of landmarks, lights and buoys, and characteristic soundings. The prices are 50 cents, 75 cents, and one dollar, depending on the size of the chart.

CONGRESS NEWS

Election of Officers for 1959

The Nominating Committee appointed by President W. B. Williams—Helmuth Bay, *Chairman,* Robert H. Lyddan, and Roland H. Moore, with Walter S. Dix secretary ex officio to the committee—met on October 28, 1958, and hereby presents the official slate of candidates, each of whom has accepted the nomination and the responsibility of office if elected by ballot of the membership for the coming year.

For President (one year term)

GEORGE C. BESTOR, Carmel, Calif.

For Vice President (one year term)

H. ARNOLD KARO, Washington, D. C.

For Directors (two year term). To fill five terminating seats on the Board of Direction.

C. J. AGGELER, San Francisco, Calif.
WILLIAM C. CUDE, Alexandria, Va.
JOHN A. LAW, Arlington, Va.
CLIFFORD A. THORPE, JR., Falls Church, Va.
JAMES P. WEBB, Arlington, Va.

The above slate has been carefully selected under provisions of ACSM Constitution and Bylaws in the best interests of ACSM to balance out the incumbent Board of Direction both technically and geographically.

Ballots are scheduled to be mailed to the membership during the final quarter of 1958 so that election results can be announced as early as possible in the new year. Actual induction of officers will take place during the 19th Annual Meeting in March, 1959, the incumbent officers remaining in office until that time.

Brief biographies of the candidates follow.

GEORGE C. BESTOR

George C. Bestor, born July 10, 1902, in Minneapolis, received his education in Minnesota. With early experience in surveying during the construction of the Alaska Railroad, he returned to the University of Minnesota to receive a B.S. in Civil Engineering in 1924.

Upon graduation he gained experience in the oil industry which included several years in Australia. During that time he was influential in introducing American-type filling stations to that country. Returning to the United States he was soon faced with depression years so familiar to many engineers, and during that period he operated a wholesale dress business—which was probably as far from engineering as one could get.

Five years of Civilian Conservation Corps duty with the Army was followed by five years of wartime service, half of the latter again in Alaska.

He established a private engineering and surveying practice in Carmel, Calif., in 1946, and has maintained offices there since that time. These operations include subdivision work, land planning, and general engineering and surveying.

Active in professional affairs, he is a member of the American Society of Civil Engineers and the Urban Land Institute. This year he has been President of the California Council of Civil Engineers and Land Surveyors. As present Vice President of ACSM he has attended the International Federation of Surveyors congress in Holland with President Williams, staged the successful first ACSM Western U. S. Regional Conference at Monterey, Calif., and was influential in organizing the Oregon Section of ACSM and the proposed Utah Section of ACSM.

H. ARNOLD KARO

Rear Admiral H. Arnold Karo, Director, Coast and Geodetic Survey, was born at Lyons, Nebr., December 24, 1903. His primary- and secondary-school education was received at Lyons, and he graduated from the University of Nebraska in June 1923 with a degree in civil engineering. He received the honorary degree of Doctor of Science at Union College in February 1958.

He entered on duty with the commissioned service of the Coast and Geodetic Survey in 1923 and has, during his 35 years of service, progressed from Ensign to Rear Admiral. He has been the Director of the Survey since August 1955. His service with the Survey has taken him to Alaska, the Philippines, the West Indies, as well as the Atlantic, Gulf, and Pacific Coast of the United States.

During World War II he was transferred to

the Army Air Forces, and for more than two years served as the commanding officer of the Air Forces Aeronautical Chart Plant, St. Louis, Mo., with the rank of Colonel.

Prior to his appointment as Director, he served for four years as the chief of the Division of Charts.

Admiral Karo is Chairman, Committee on Cartography, National Academy of Sciences, National Research Council, which serves in an advisory capacity to the Department of State on matters connected with United States participation in the work of the Commission on Cartography of the Pan American Institute of Geography and History.

He is a member of the American Geophysical Union, United States Naval Institute, American Society of Photogrammetry, Cosmos Club, Sigma Xi, and Sigma Tau. He is also the C&GS member on the Mississippi River Commission.

C. J. AGGELER

C. J. Aggeler was born in California in 1902. He was named Cecil James Aggeler but is more widely known to Pacific Coast surveyors and engineers as "Mike" Aggeler. He received a B.S. in Engineering at the University of California in 1926. With the Pacific Gas and Electric Company from 1926 to 1936 he surveyed, mapped, computed, and wrote and interpreted land and easement descriptions.

An educator from 1936 to date, he has been Surveying and Mapping Instructor at City College of San Francisco since 1939. He started a two-year Technical Program in Surveying and Mapping in 1947, which, in 1957, has since been accredited by E.C.P.D. In 1958, C. J. Aggeler was appointed Engineering Department Chairman of San Francisco's City College, which currently has an enrollment of 6000, with 25 engineering instructors.

Active in ACSM since 1951, he helped organize the Northern California Section in 1951, and was elected Chairman of the Section in 1953. As Chairman of the Section's Education Committee for the past several years, he has organized classes for surveyors, taught classes for surveyors, and met with groups of surveyors throughout Northern California to discuss the State Coordinate System and the California Land Surveyor's Act. Mike Aggeler was Program Chairman for the recent first and successful ACSM Western Regional Conference, held at Monterey, California, October 9–11, 1958.

WILLIAM C. CUDE

William C. Cude was born in Tennessee and received his education at the McTyeire Preparatory School, McKenzie, Tennessee; Maryville College, Maryville, Tennessee; and Louisiana Tech, Ruston, Louisiana.

Mr. Cude was employed for six years in the Vicksburg, New Orleans, and Florida District Offices of the Corps of Engineers, where he was engaged in flood control, dredging, levee construction, surveying and mapping of cross state canal sites and the intracoastal waterways. He was for seven years engaged in mapping and surveying activities for the Soil Conservation Service, U. S. Department of Agriculture.

During the war years, he served with the U. S. Army Corps of Engineers, attaining the rank of Lieutenant Colonel, assigned to military research and development at The Engineer Board, Fort Belvoir, Virginia, and in the Pacific Theater.

For the past eleven years, Mr. Cude has served as Chief, Topographic Engineering Department, U. S. Army Engineer Research and Development Laboratories, Fort Belvoir, Virginia. In this capacity, he directs research and development of mapping and geodetic equipment for the Corps of Engineers.

Mr. Cude has been a member of the American Society of Photogrammetry since 1935, served as a Director from 1945 to 1947, First Vice President, 1955, and President, 1956. He was Director and Treasurer of the International Society of Photogrammetry from 1947 to 1952. Mr. Cude is presently the Chairman of the Committee on Photogrammetry, American Roadbuilder's Association. He is also a member of Society of American Military Engineers, and the American Geophysical Union.

W. C. Cude's name will be found on the roster of persons who attended the first Congress on Surveying and Mapping back in 1941. Since then his active interest often has been witnessed by splendid effort and cooperation of ERDL in ACSM exhibit presentations and program participation.

JOHN A. LAW

John A. Law graduated from the South Dakota School of Mines and Technology in 1930 as a Civil Engineer, and from that time until 1947 was with the U. S. Geological Survey on surveys in Eastern, Mid-Western, and South-Western United States. In 1947 he was assigned to the Atlantic Region Office of the U. S. Geological Survey as Chief of Drafting. Later

he was Chief of Editing and then Assistant Chief of Section. In 1956 he was transferred to the USGS staff in Washington, D. C., as Chief of Field Surveys Section. Presently he is Assistant to the Chief Topographic Engineer. An active member of ACSM, he is past-chairman of ACSM's Cartographic Division.

CLIFFORD A. THORPE, JR.

Clifford A. Thorpe, Jr., graduated in engineering from Georgia Institute of Technology and also from Atlanta Law School. In 1940 he was Superintendent of the H. B. Nelson Construction Company engaged in locating and constructing transmission lines on the Santee-Cooper Project. A member of the 1942 class of the U. S. Coast Guard Academy of New London, Conn., he was made Commanding Officer of the Wailupe Training Station at Honolulu, Territory of Hawaii, where he served three years.

Returning to the United States in 1946, he served with the Air Sea Rescue Board in the Airborne Equipment Section, Engineering and Development, U. S. Coast Guard. Leaving the Service for civilian life, he was for several years associated with C. L. Berger & Sons, engineering and surveying instrument makers of Boston. He presently is the Thorpe of Thorpe-Smith Incorporated, an engineering and surveying instruments firm formed in 1954 in Falls Church, Va.

He has served ACSM's Instruments Division for several years as its Secretary, and for the past two years as its chairman.

JAMES P. WEBB

James P. Webb was graduated in civil engineering at Louisiana Polytechnic Institute, with additional work at George Washington University. He took further work in geodesy at the U. S. Department of Agriculture Graduate School, Washington, D. C. and work in photogrammetry at Marquette University and also in Germany at the University of Munich.

With the Soil Conservation Service, USDA, he conducted planetable and construction surveys in Louisiana and Texas from 1934 through 1940.

In 1941 he went with the South Atlantic Division, Corps of Engineers, conducting geodetic control surveys in the field and supervising photogrammetric mapping on reservoir topography and dam sites in Virginia, North and South Carolina, Georgia, and Alabama. In 1945 he did field and photogrammetric work with the Coast and Geodetic Survey on coast and harbors.

In 1946 he went with Army Map Service, Corps of Engineers, where, since 1951, he has been Assistant Chief of the Division of Photogrammetry, responsible for advising and administering technical phases of that agency's worldwide large and medium scale mapping program.

He is author of the Corps of Engineers' Topographic Mapping Manual for Civil Works and articles published in Photogrammetric Engineering. He is active in both the American Congress on Surveying and Mapping and the American Society of Photogrammetry, just completing a term as a member of the Board and Executive Committee of ASP, and having recently been ACSM Program Chairman for the 17th Annual (1957) Meeting, and Convention Director for the 1958 ACSM–ASP Consecutive Meetings.

A Note to ACSM Members on Board Balance and Addresses of Candidates

By ACSM Constitution the Nominating Committee is charged to—"select candidates . . . from as varied a field of surveying and mapping as practicable . . . including major government agencies, instrument and commercial firms, cartographers, geographers, map publishers, educators, and private practice engineers and surveyors."

Traditionally, the Nominating Committee also considers the geographic interest in membership participation. Too, the practical matter of getting business done, the actual mechanics of meeting and working, must be considered.

Perfect balance of so many facets or phases in equilibrium amongst sixteen members of the Board of Direction—four executive officers and twelve directors—is not achieved haphazardly or by chance. It takes diligent and earnest deliberation, and by one of the most carefully selected and carefully instructed committees in ACSM annual operations. One might call it the "G-2" of ACSM for comparison of applied intelligence.

This explanation is made to the membership at this time in order that the apparent preponderance of "close to Washington" addresses of four of the five directors nominated on the official slate does not cause undue alarm as some-

times in the past under similar circumstances the Nominating Committee has been censured for "stacking the deck" so to speak.

This grings me to the points I wish to stress. *First,* total balance technically and geographically is concerned with the *whole* Board of Direction, not just the five directors replacing the outgoing increment.

Secondly, most of the candidates with Washington, D. C., or nearby addresses, are actually native of other localities just as are the very U. S. Congressmen sent to the Nation's Capital to work. The biographies of candidates will reflect the broad and rooted interest as well as their technical or professional qualifications, and should counterbalance any bias of incidental or contingent address. You will all agree, I feel sure, that assigning an individual to fields afar from home does not necessarily change his citizenship and rarely if ever lessens his inherent interest in his homeland.

WALTER S. DIX
Secretary ex officio to the Nominating Committee

Cartography Division Meeting

The Cartography Division of the American Congress on Surveying and Mapping held an open meeting in the Department of the Interior Auditorium, Washington, D.C., on Thursday evening, November 6, 1958, at which two extremely interesting talks were given.

Lieutenant Commander John H. Nicholson, USN, spoke on "The Voyage of the U.S.S. *Skate* Below the Arctic Ice Pack." Commander Nicholson, who was the Navigator and Executive Officer of the U.S.S. *Skate* during the historic voyage of this nuclear powered submarine, gave a firsthand account of the voyage beneath the polar ice.

Captain Elliott B. Roberts, Coast and Geodetic Survey, spoke on "Moscow Today" and narrated his experiences and impressions as a delegate to an International Geophysical Year conference in that city.

Proposed 1959 ACSM Western U. S. Conference

At a luncheon meeting on Saturday, October 11, 1958, during the Western Regional Conference at Monterey—presided over by ACSM Vice President George C. Bestor and attended by officers and representatives of ACSM Sections in the western part of the United States, as well as President John I. Davidson of the American Society of Photogrammetry and ACSM Executive Secretary Dix—Chairman Harvey Rookus of the Southern California Section was given ACSM unanimous approval to proceed with plans for a 1959 ACSM Western U. S. Conference, with authority to negotiate with the Southern California Section of the American Society of Photogrammetry regarding possible "consecutive meeting" cooperation, since the ASP group also planned a 1959 Western Semiannual Meeting.

ACSM Sections represented at the meeting were: Northern California, Southern California, Colorado, Oregon, and the Arizona, New Mexico, Nevada, Utah, and Washington State areas of Section interest. President Bestor indicated that the Texas Section of ACSM had previously concurred in correspondence.

Northern California Section

Fifty surveyors, coming principally from Solano, Contra Costa, and Alameda Counties, attended the local meeting of the Northern California Section held on July 30, 1958, at Vallejo Junior College in Vallejo. Cosponsored by the City of Vallejo and the Northern California Section, the meeting featured talks on the California Coordinate System by Charles A. Wooldridge and William Angeloni.

Mr. Wooldridge briefly covered the theory of the system and explained (1) the practical field use of the system as an aid in checking the accuracy of traverses and lower order triangulation, (2) how to avoid complicated computations by the use of Coast and Geodetic Survey tables prepared for the purpose, and (3) some general rules for the use of right triangles to check the over-all results and to avoid becoming involved in computing spherical excess.

Mr. Angeloni spoke on his experience in the use of C&GS triangulation stations as control points in connection with the coordinate system in surveying Army and Navy real estate. Although he acknowledged that a point established by the system could be relocated by it with certainty and a minimum of labor, he did not believe that the system had much application in land title surveys because it some-

times results in positions which are at variance with long-accepted positions given in abstracts of title.

—Paul J. Dowling
Section Editor

Chairman C. O. Greenwood arranged a panel discussion of the subject "Mapping Specifications" for the meeting held at 7:30 p.m., November 7, 1958, in the Hearing Room of the Public Works Building at Sacramento, Calif. The speakers were—V. S. Seward, U. S. Geological Survey, Moderator; Hugo Hall, U. S. Bureau of Reclamation; Rex Fulton, California Division of Highways; Logan Muir, Packard, Muir and Train; Kedall Wood and C. O. Greenwood, alternates.

On October 3, 1958, the Section met at Fresno State College. Professor Ed Kulhan and Mr. Lawrence Vance spoke on the California Coordinate System.

Southern California Section Holds Annual Field Day

If and when the Los Angeles Dodgers baseball club builds a ball park in Chavez Ravine in Los Angeles, they will find they are in the right place. This was determined as part of the demonstration of the Tellurometer at the annual field day of the Southern California Section, held near the site of the controversial ball park on June 28. Albert Cocking and Harmon Rasnow of Aerial Controls, Inc., who handled the demonstrations, reported that measurements made with this instrument disclose that the city maps and control stations in the area are correct within measurable limits.

Albert Cocking and Mel Gant (*left to right, with ties*) explain the operation of the Tellurometer. Mr. Gant, as Program Chairman for the Section, planned the excellent field day program.

The more than 100 surveyors who attended the all-day event also witnessed demonstrations of first-order base line measurement with an invar tape and first-order angle measuring with the Wild T-3 theodolite, sponsored by the Los Angeles Engineering Department Survey Division. Ben O. Badgley, Chief Surveyor, and Alfred Boysen, Supervisor, conducted these demonstrations.

Throughout the day, the local representatives of the instrument companies displayed the latest of all types of surveying equipment. One particularly interesting exhibit, furnished by Pacific Air Industries, depicted the step-by-step procedures for the making of a topographic map of the area where the program was held.

—R. T. White
Section Editor

Colorado Section

The Colorado Section of the American Congress on Surveying and Mapping in conjunction with the Rocky Mountain Section of the American Society of Photogrammetry honored ACSM Executive Secretary Walter S. Dix and ASP President John I. Davidson at dinner on Thursday evening, October 16, 1958, in Denver, Colo.

After the dinner a meeting was held in the U. S. Geological Survey auditorium at the Federal Center. Howard J. Summers, Vice Chairman of the Colorado Section and Tom Cummins, Vice President of the Rocky Mountain Section, respectively, did the honors for their organizations.

Speaking for ACSM, Secretary Dix briefly stressed the importance of Section activity as the strength and life of a national congress. President Davidson presented his scheduled report from the American Society of Photogrammetry to its Rocky Mountain Section.

North Carolina Section

The Executive Committee of the North Carolina Section met on October 18, 1958. Section Chairman Benjamin E. Kirkman has appointed Edgar H. Kimmons as chairman of the Membership Committee. Secretary W. Thompson Cox reported a good membership nucleus to which the present membership drive will add.

With the newly adopted constitution ready for distribution, the Section organization is ready to become really active, and many new members are expected.

A regular meeting of the Section was scheduled for November 8, 1958.

Oregon Section

At a meeting of the Oregon Section, ACSM, held in Portland, Oregon, September 13, 1958, the following officers and directors were elected:

Fred Darby, *Chairman*
C. R. Keeney, *Vice Chairman*
Alan C. Givens, *Secretary-Treasurer*
A. D. Graham, *Editor*
Donald Knowles, *Director*
Jay B. Boyd, *Director*
J. B. Gearhart, *Director*
H. B. Schminky, *Director*
Dexter Milne, *Immediate Past Chairman*

—Alan C. Givens
Secretary-Treasurer

The Oregon Section of ACSM was officially chartered on August 18, 1958. Several Oregon members, including Chairman Fred Darby, editor A. D. Graham, and Director H. B. Schminky met with ACSM Vice President Bestor and Executive Secretary Dix during the U. S. Western Regional Conference at Monterey, Calif., and discussed many matters of local and national program interest.

St. Louis

The St. Louis Section of ACSM is well on its way to active organizational programing. Officers and chairmen are as follows:

Chairman—Frank A. Clemens
Vice Chairman—Edmund M. Thompson
Secretary—William Cannell
Treasurer—R. Thompson
Editor—Sheridan L. Hall
Directors—S. Sanders
Arthur L. Zeigler
Lloyd T. Whisnant, Jr.
Michael J. Blanchfield
William T. McGee

Committee	*Chairman*
Program	Ed Reed
Membership	Bart Higgins
Publicity	Tom Caldwell
Cartography	Gordon Stine
Education	Nelson Clark
Instruments	P. Bosmeyer
Property Surveys	E. Rowland
Topography	Ralph E. Dale
Map Reproduction	Robert M. Kuthe

On the night of October 17, 1958, ACSM Executive Secretary Dix met with the above group in informal session at the home of Chairman

Clemens on the outskirts of St. Louis, Mo., at which meeting national and local matters were openly discussed in objective interest to Section activity. Interest ran high, and questioning and answering continued into Saturday, with the meeting closing in the wee small hours. Chairman Higgins of the Membership Committee reports close to 300 members at present, with expectations of many more in the near future. Regular quarterly meetings are planned, with special events as occasioned.

The first business meeting of the St. Louis Section was held September 23, 1958, with very good attendance. The Tellurometer was demonstrated by Floyd W. Hough, consulting geodetic engineer, with the aid of an associate. Clarence Crouch of the Keuffel & Esser Company also demonstrated several instruments newly developed by his company.

A key objective of the St. Louis Section is a high degree of active participation in Section activities.

Reported to ACSM Secretary by
SHERIDAN L. HALL
Section Editor

Texas Section

As preludes to the second quarterly meeting of the Texas Section, held at John's Restaurant in Houston on June 13, a cocktail hour followed by an excellent dinner gave the 67 members and guests attending an opportunity to renew acquaintances and "talk shop" before the more serious business of the meeting began.

Opening the meeting, Section Chairman Leonard Cornitius requested a report from the Section Treasurer. The report disclosed that there were 17 new members since the last meeting, making a total of 230 members in the Section.

John Phillips, Program Chairman, introduced the guest speaker, Jack Ammann of Jack Ammann Photogrammetric Engineers, Inc. Mr. Ammann spoke on the subject, "What Is the Meaning of Photogrammetry?" He began with a description of an early-day stereoscope like the one Grandma had, which cost $3.65 from Sears, Roebuck and Co. in 1895, and progressed to present day equipment and applications in public service and industry. The presentation was thoroughly enjoyed by the members present.

—ELLIS S. ALLEN
Section Editor

Utah

Preliminary work of activating the Utah Section of the American Congress on Surveying and Mapping is well under way. ACSM Executive Secretary Dix reviewed petition and constitutional matters with Utah Chairman Gerald FitzGerald during the U. S. Western Regional Conference of ACSM, October 9–11, 1958, at Monterey, Calif., and all indications are that the Utah Section will be effected before the end of 1958.

Dix Visits U.S.G.S. Pacific Region Office

On October 14, 1958, ACSM's Executive Secretary Dix made a "flying" visit to Sacramento, Calif., for a very brief review with Vernon S. Seward and Robert E. Altenhofen, of U.S.G.S. Pacific Region cartographic techniques, at their invitation following discussion at the Western Regional Conference in Monterey. Mr. Seward was organizer and first chairman of the Northern California Section of ACSM and remains very active in the area. He was scheduled to serve as Moderator of a panel of experts on Mapping Specifications arranged by Northern California Section Chairman C. O. Greenwood for presentation on November 7, 1958.

MAKE YOUR PLANS NOW TO ATTEND THE 1959 ASP–ACSM COMBINED MEETINGS AND CO–EXHIBIT

Personals

Joseph P. Dunich and **Joseph Steinberg** were members of a group which received cash awards at a ceremony held in the office of Admiral **H. Arnold Karo,** Director, Coast and Geodetic Survey, one day last September. Lyman D. Lynn, who compiles the "Current Surveying and Mapping Literature" feature for SURVEYING AND MAPPING, was also among the award winners on that occasion.

George D. Whitmore, Chief, Topographic Division, U. S. Geological Survey and Past President of the American Congress on Surveying and Mapping, recently received a Distinguished Service award from the Department of the Interior.

James L. Bell of Mission, Kans., Chairman of ACSM Property Surveys Division Committee on Study of Fees and Salaries, was the luncheon speaker for ACSM at the annual meeting of the Missouri Association of Registered Land Surveyors at Rolla, Mo., on October 4, 1958.

Russell C. Brinker, P. E., and Rear Admiral, CEC, USNR (Ret) became Professor of Civil Engineering at Texas Western College, El Paso, Texas, with the opening of the fall term.

Roman P. Sobey, formerly construction cost estimator with DeLeuw, Cather and Brill, has joined the firm of Shumavon and Buckley, consulting engineers, as a survey and cost engineer.

Talbert Abrams, Chairman of the Board of Abrams Aerial Survey Corporation and President of Abrams Instrument Corporation, Lansing, Mich., flew as a passenger on Pan American World Airways' first scheduled New York to Paris flight in Pan Am's new Boeing 707 Jetliner.

A pilot since 1917, Mr. Abrams gives the highest praise for the performance of the "707" and its crew. In commenting on the speed and range of the "707," Mr. Abrams observed that the use of similar equipment by commercial air-mapping agencies would permit photographic operations in Europe, with the film exposed during the day being processed the same night in the United States.

Deaths

Word has been received at the ACSM Central Office of the deaths of the following members of the American Congress on Surveying and Mapping. No further details are available.

Robert J. Bartley, Civil Engineer, Robert J. Bartley Associates, One Fifth Avenue, Bay Shore, N. Y.

John D. Cornelius, Civil Engineer and Land Surveyor, 117 West Sunrise Highway, Freeport, N. Y.

Lawrence R. Smith of Falls Church, Virginia, member of the surveying and engineering instruments firm of Thorpe-Smith, Inc., died suddenly on November 3, 1958.

Professor **Charles Blaney Breed,** who was probably most widely known for his authorship, with Professor George L. Hosmer, of "Principles and Practice of Surveying," died at Camden, Me. on August 9, 1958.*

He graduated from the Massachusetts Institute of Technology in 1897, but his first engineering experience seems to have been with the engineering department of the city of Lynn, Mass., beginning in 1894. If this information is correct, having been born at Lynn, Mass., November 28, 1875, Professor Breed must have begun his engineering career at the early age of 18 or 19 years.

Entering on duty as a member of the faculty of the Massachusetts Institute of Technology in 1906, he continued as professor of railroad and highway transportation until his retirement in 1945. He served as head of the department of civil engineering at the institution from 1935–1945.

At one time or another Professor Breed served as president of the Boston Society of Civil Engineers, the New England Railroad Club, and the Breed Family Association. He was a director of the American Society of Civil Engineers. He was a member of the American Railway Engineering Association, American Road Builders Association, Chi Epsilon, Sigma Xi, Tau Beta Phi, and the American Congress on Surveying and Mapping.

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* This date was given in *Science,* 29 August 1958, while an obituary notice in *Engineering News-Record,* August 21, 1958, gives the date of Professor Breed's death as August 11, 1958.

A Correction

In the obituary of Willie Oliver Byrd (*See* SURVEYING AND MAPPING, July–September 1958, Vol. XVIII, No. 3, page 359) the first sentence beginning in the second column might better have read "From 1936 to 1946 he served in the computing office of The Maps and Surveys Branch of the Tennessee Valley Authority, from which he went to the Pacific Island Engineers in Guam." This correction is based on information supplied by William S. Massa, of Chattanooga, Tenn.

In self defense, the editor wishes to point out that *this* mistake was not an editorial blunder. He followed the copy furnished. The correction is appreciated because it corrects a real misstatement. Mr. Byrd actually spent less than one year in Guam.

—EDITOR

And Then There's Alaska

By GWEN SCHULTZ

INSTRUCTOR IN GEOGRAPHY, THE UNIVERSITY OF WISCONSIN

MAPMAKERS everywhere must be bemoaning the passing (or expanding) of one of the neatest, compactest, page-fittingest countries in the world, the good old rectangular U.S.A. (with handy spots for legend boxes).

Now, as we christen Alaska the forty-ninth State and take our place among the cartographic conundrums, like divided Pakistan, scattered Indonesia and stringbean Chile, the classic writings on map design will be resurrected and scrutinized, and the bottoms of barrels labeled "Balanced Layout" and "Principles of Proportion" will be scraped clean.

Pictorial cartographers may temporarily find delight in depicting the U.S.A., as a westward-facing animal, rubbing Diomedic noses with the U.S.S.R., while threatening with its Attu-tipped tusk. But what actually is a standard map of the United States to look like? The sprawling, appendaged Alaskan territory, so accustomed to being bisected by the binding of an atlas or being chopped into insets—what will it experience now at the hands of mappers? Will it be allowed by its bulk to dominate the regular "48?" Will it be scaled down? Will it be mutilated, maybe even becoming an inset containing insets? Or will it be conveniently eliminated by such titular escapisms as "The United States (except Alaska)?"

And how will cartographers arrange spread lettering across our new interrupted national expanse? They will find some way. They always do. Perhaps the problem could be met most simply by campaigning for the elimination of the Canadian Corridor.

Think of the quantity of existing "United States" maps that will have to be redrawn or renamed! The statistical maps that will need revision! And what about conventional terminology? What now will be The South? The Northwest Coast? The central section of the country?

But if mapmakers have it bad, pity even more the persons writing books or teaching courses in the geography, history, or anything else of the United States!

And then there are the Hawaiian Islands—.

Silver Anniversary
Bausch & Lomb Honorary Science Award

The 25th anniversary of the Bausch & Lomb Honorary Science Award program was observed June 15–17, 1958, in Washington, D. C., the climax of the affair being the Silver Anniversary Luncheon on the 17th.

The Bausch & Lomb Honorary Science Award is a distinctive bronze medallion that is made available without cost to any high school or preparatory school in the United States which offers three science subjects. It is awarded annually by each participating school to its best science student.

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Previous Issues of "Surveying and Mapping"

The following extracts from recent correspondence with Prof. Carl F. Meyer, Professor of Civil Engineering, Worcester Polytechnic Institute, are quoted in order to furnish information to our membership regarding the availability and cost of previous issues of SURVEYING AND MAPPING:

August 22, 1958

We recently subscribed to SURVEYING AND MAPPING. . . . We are now in a position to enlarge our coverage of technical magazines in the Civil Engineering Library. I am so impressed with SURVEYING AND MAPPING that I am recommending we bind the issues for permanet library reference. In fact, the principal object of this letter is to inquire whether complete sets of the issues for Volumes XVII, XVI, and earlier could be made available to us in order to make our library file as valuable as

possible. I would appreciate knowing how many of the earlier volumes we could obtain and what the cost would be.

CARL F. MEYER

August 28, 1958

We regret that the supply of several issues of our Journal is exhausted. Of the 46 issues, published in the present $7'' \times 10''$ size, from 1946 to 1957, inclusive, 40 issues can be furnished. The missing issues are two in 1956 and one each in 1949, 1950, 1951, and 1956. To members of the Congress copies of this size are sold at $1.00 per copy, plus postage or express charges.

Prior to 1946 the page size of our Journal was $6'' \times 9''$. From 1941 to and including 1945 there are about 16 issues available. These are sold at 50 cents a copy, plus postage. The total cost of all available issues would not exceed $50.00.

A.C.S.M.

September 15, 1958

We would like to accept the opportunity to obtain all 40 available issues for the years 1946 to 1957, inclusive. Despite the few gaps, we feel that our Civil Engineering Library should contain SURVEYING AND MAPPING for those years. . . .

CARL F. MEYER

Professor Meyer apparently has a fine sense of humor. When reminded that our unusually tall former president, Mr. Carroll Merriam, was from Worcester Polytechnic Institute, he wrote back:

Yes, I knew of Mr. Merriam being President of your Society a few years ago. I remember him quite well when he taught here at W.P.I. a good many years ago. After all, how could anyone forget a person of Carroll Merriam's altitude?

Survey Divers Attempt to Solve Riddle of Migrating Sand Ridges

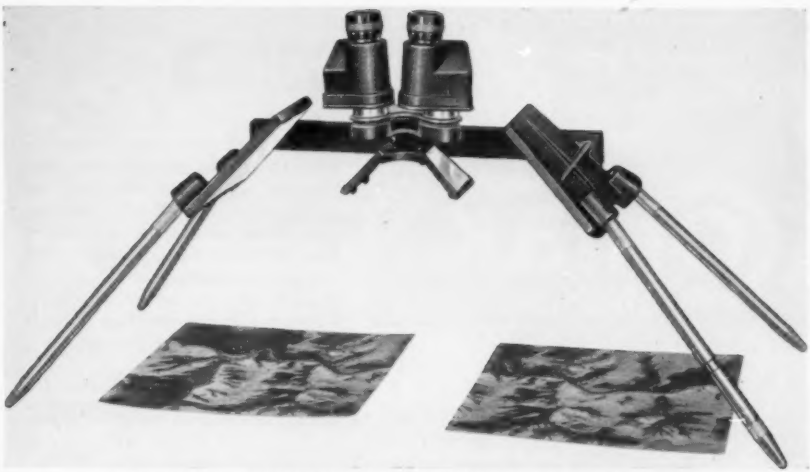
During a special oceanographic research project in August 1958, oceanographers of the Coast and Geodetic Survey attempted to unravel the mystery of the apparent migration of underwater sand ridges on Georges Shoal, located about 120 miles off Cape Cod. The project also included current measurements at the edge of the continental shelf and about 600 feet below the surface.

Recent surveys of Georges Shoal revealed a change in position for the elongated, underwater, sand ridges that cross the crest of this offshore bank. This apparent movement may be the result of more accurate surveying methods, adopted since the last survey 26 years ago, but Bureau oceanographers are confronted with other information which suggests actual movement of the ridges, some of which are 4 miles long, up to 40 feet high, and rise to within 20 feet of the surface.

The strong currents in the area (nearly 3 knots) uphold this theory, but up to this past summer systematic sampling and visual observations have not been possible. During August Dr. Harris B. Stewart, Jr., and Garrett G. Salsman, both experienced aqua-lung divers, armed with motion picture cameras, still cameras, color film, colored dyes, and sampling devices, made visual observations and took both motion and still pictures for study in the office. Sediment samples from specific locations on the ridges were also taken.

The current observations at the edge of the continental shelf were made with two strings of three current meters each lowered to 15-foot depth, mid depth, and as near the bottom as practical, the strings of meters being supported by two large buoys located about 10 miles apart. The direction and velocity of the current, as determined by each of the six current meters, were radioed to the Ship *Hydrographer* which was standing by between the two metering stations.

There seems to be speculation among oceanographers that currents along the outer edge of the continental shelf should be stronger than those closer inshore, but actual measurements have not been made. Besides answering an academic question, it is hoped that these current measurements will provide data on an important technical problem now facing this country, the role of bottom currents in transporting and dispersing any atomic contaminants that may find their way into the sea.



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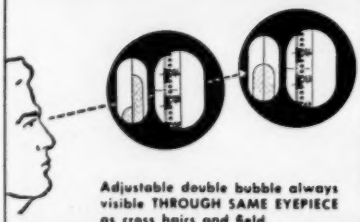

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MEETINGS

PAST, PRESENT, AND FUTURE

The annual Surveyors Institute of the University of Wisconsin, University Extension Division in cooperation with the College of Engineering, was scheduled to be held at Madison, Wisconsin, December 3–5, 1958.

The 1959 ASP–ACSM Convention and Co-Exhibit will be held March 8–14, 1959, at the Shoreham Hotel, Washington, D. C.

GEOGRAPHIC NAMES

The responsibility for coordination of staff work on domestic geographic names, previously assigned to the Office of Geography of the Department of the Interior, was transferred to the Geological Survey on October 1, 1958. Functions of the Board on Geographic Names, composed of representatives of eleven Federal departments and agencies, is not affected by this transfer. The Board, established by Congress in 1947, is responsible jointly with the Secretary of the Interior for standardizing geographic names and spellings for use on maps and in other publications issued by Federal agencies. Staff work for foreign geographic names will continue to be a function of the Office of Geography.

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An 8-page, two-color folder, titled "Map Reproduction—Modern Equipment and Procedures" and describing a complete line of this type of equipment, has been published by Klimsch & Co., Frankfurt–Main, West Germany. Repro Graphic Machines, Inc., 180 Varick St., New York 14, N. Y., represents Klimsch & Co., in the United States and Canada. Presumably copies of the booklet are available from the New York address.

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WALL MAP OF CARIBBEAN AREA

A new wall map, published by Denoyer-Geppert Company, is the eighth in its Visual-Relief Series, covers Central America and the Caribbean area, and has been drawn to a scale of 35 miles to the inch. Special insets have been included for the Canal Zone and for Puerto Rico. The map size is 64 by 44 inches.

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HELIOS BLUE 11

The Keuffel & Esser Co., reports that a three-month test by users of their new Helios Blue 11 has resulted in an average saving of time of about 30 percent. The new paper was not designed to replace other paper speeds but to fill a need where slow downs constitute a problem. Samples of the new paper are available for testing.

NEW U. S. G. S. BUILDING AT MENLO PARK, CALIFORNIA

Building No. 3 in the Pacific Coast Field Center for the U. S. Geological Survey in Menlo Park, Calif., is under construction. By midsummer of 1959 it is expected to house the Survey's topographic mapping operations on the west coast.

Buildings No. 1 and No. 2 occupied by operations of the Geologic, Water Resources, and Administrative Divisions are under lease. A fourth building is planned for the future.

The completion of Building No. 3 in the early summer of 1959 will allow the move from Sacramento to be made at a time of year when there will be the least disruption for the technical programs under way and for the personnel and families involved in the move.

"VISUALIZATION MADE EASIER"

More years ago than the writer likes to think about, there was a rash of jokes or gags about "striped paint." Now Chart-Pak, Inc., is offering *rolls* of dotted and/or dashed lines. Their new brochure, "Visualization Made Easier," describes these and a multitude of other pressure-sensitive tapes of various styles and patterns; the means of applying them easily and accurately in the production of charts, graphs, and layouts; and may be obtained without charge from Chart-Pak, Inc., Leeds, Mass.

"100 JAHRE KLIMSCH"

Klimsch & Co. Frankfurt-Main, West Germany (represented in the United States by Repro Graphic Machines, Inc., 180 Varick St., New York) has recently issued a 24-page publication in commemoration of the 100th anniversary of the founding of that company. The brochure is beautifully illustrated, with many of the illustrations in full color, and describes (in four languages— German, English, French, and Spanish) the founding and development of this internationally known organization for the production of lithographic equipment.

NOW WE HAVE SEEN EVERYTHING

A cartoon on page 54 of the August 1958 issue of *The International Blue Printer* shows a two-man field party using a gimmick that appears to be an instrument partaking of the characteristics of both a level and a transit. The observer is calling off the "statistics" concerning a curvacious gal walking toward the instrument. But the thing that intrigues us most about the whole thing is the fact that the "tripod" obviously has *four legs*.

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CHARTS FOR SMALL BOAT NAVIGATION

Thousands of small boat owners, who recently furnished comments and suggestions* to the Coast and Geodetic Survey concerning the development of special charts for small craft, will be interested to know that construction of the first experimental editions is under way.

* *See* SURVEYING AND MAPPING, July–September 1958, Vol. XVIII, No. 3, page 366.

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"BELIEVE IT OR NOT"

If you find a mistake in this Journal, please consider it was put there for a purpose. We try to publish something for everyone, and some people are always looking for mistakes.

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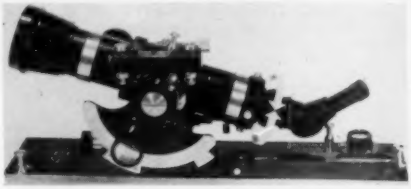
NEW ELBOW EYEPIECE

A new elbow eyepiece developed to fill the need for an instrument which will be easier to read in the field, has been added to the Gurley alidade. It extends in a diagonal direction from the end of the alidade telescope and can be rotated in any position and read from either side. The new eyepiece permits the topographer to view his target with greater comfort and convenience. Instrument men who have used pilot models state that the alidade is now easier and faster to use and that there is less danger of the instrument being accidentally moved out of position. Men who wear glasses report that there is no longer a problem in getting the eye close to the eyepiece.



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METRIC SYSTEM FOR JAPAN

We note, in *Science*, 26 September 1958, Vol. 128, No. 3326, that the Japanese Government proclaimed, about a year ago, the adoption on a nationwide basis of the metric system for use in that country. A period of grace, extending from October 1 to December 31, 1958, has been set up for the change-over, after which commercial organizations and others using the old measures will be subject to fines ranging up to 50,000 yen—something of the order of size of $140.

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GEODETIC CONTROL FOR HIGHWAY SURVEYS IN PENNSYLVANIA

An agreement dated March 18, 1958, between the Coast and Geodetic Survey and the Department of Highways of the Commonwealth of Pennsylvania calls for the establishment of geodetic control, both horizontal and vertical, along 900 miles of the Interstate Highway System in that State. Field work was begun early in May 1958.

Horizontal-control points are being established at intervals of from two to five miles, and vertical-control points are being established at intervals approximating one mile.

The Coast and Geodetic Survey already has agreements with seven other States for similar work—Delaware, Maryland, Maine, Mississippi, Nevada, Virginia, and Washington.

LIST OF PUBLICATIONS

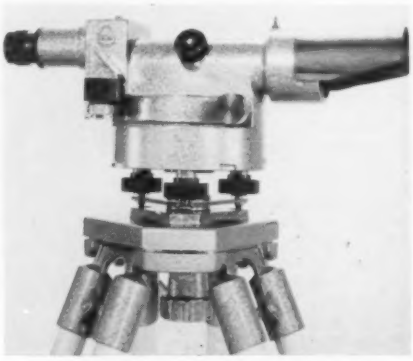
A new list of publications, incorporating the titles of all geological reports, preliminary reports, circulars, bulletins, and maps published by the Ontario Department of Mines since 1891 has been prepared for distribution through the publications office of the Department. The list is complete to April 1958. The last previous edition was published in 1956.

It is the policy of the Department to make single copies of most reports available without charge provided they are to be used for mining purposes. A scale of prices for extra copies is included in the new list of publications.

ANOTHER AUTOMATIC LEVEL

Another self-leveling or "automatic" level is being introduced to the American market by Precision Instruments, Inc., Troy, N. Y. This one, the Ertel "INA," is made in West Germany and is a small, compact, light instrument with a 30-power telescope having coated lenses.

A descriptive bulletin containing complete information on this level may be obtained by writing Precision Instruments Inc., 1900 Fifth Avenue, Troy, N. Y., and requesting "Bulletin PI-INA."



THE ERTEL "INA" LEVEL

NEW B & L AERIAL PLOTTER

The Bausch & Lomb Optical Co., has announced the addition of the Balplex 760 Plotter to its line of photogrammetric mapping equipment. The new "760" provides 5X enlargement of the original aerial negative, making the new instrument especially well suited for mapping of highways and waterways where large scale accuracy and detail are of primary importance.

PROGRAM PREVIEW—the coming March annual meetings

1959 ASP—ACSM Consecutive Meetings and Co-Exhibit

March 8–14, 1959, Shoreham Hotel, Washington, D. C.

ASP Twenty-fifth Annual Meeting—March 8, 9, 10, 11
Sessions—Monday, Tuesday, and Wednesday morning

ACSM Nineteenth Annual Meeting—March 11, 12, 13, 14
Sessions—Wednesday afternoon, Thursday, and Friday

ASP PROGRAM:

General topics for technical sessions at the forthcoming meetings will include:

1. Photogrammetric and related papers of historical nature.
2. Color photography in photointerpretation.
3. Special applications and measurements.
4. Cameras, lenses, and photographic materials.
5. Analytical aerotriangulation.
6. Automation.
7. General sessions (miscellaneous papers).

The annual awards and business sessions will be held in the afternoon rather than in the evening. Concurrent sessions will be run to accommodate the wide field of interest in the technical sessions.

ACSM PROGRAM:

With the exception of Education, all Technical Divisions will have separate Division Meetings. Property Surveys, Cartography, and Instruments are scheduled for Thursday morning; Property Surveys and Cartography again on Thursday evening; and Topography and Control Surveys on Friday morning. It is hoped that with this schedule members with more than one interest will be able to attend at least two meetings. Plenary sessions will be held afternoons, Wednesday through Friday.

CARTOGRAPHY: The program to be presented at the Division Meeting on Thursday morning will feature a panel discussion on the educational program in the field of geographic cartography. A session is planned for Thursday evening in which papers will be presented outlining recent developments in cartography within the various government agencies. A detailed report on the Second International Cartographic Conference held in Chicago, Illinois, June 1958, will be given at the Plenary session scheduled for Friday, March 13, 1959.

CONTROL SURVEYS: On Thursday afternoon, March 12, a panel consisting of a few engineers from representative State highway departments will discuss geodetic control surveys, as related to the Interstate Highway Program in their particular States. Enough experience has been gained to permit an intelligent discussion of this matter. A brief Business Meeting will be held Friday morning, March 13, which will be followed by papers on Ultra Precise Control Surveys for the construction of a synchrotron at Brookhaven National Laboratory, and on the present status of the problem of earth satellites as related to geodesy.

EDUCATION: Will hold a plenary session on Thursday afternoon. Dr. John D. Ryder, Dean of the College of Engineering, Michigan State University, will address the session on the subject "Are Our Engineering Colleges Modern?"

INSTRUMENTS: Plans to present programs both in a Division Meeting on Thursday morning and a plenary session Thursday afternoon to bring the members of ACSM up to date on the latest developments in instruments and in their use in the field for which designed.

PROPERTY SURVEYS: At a plenary session to be held on Wednesday afternoon, March 11, two papers will be given; one on combining photogrammetry and surveying to resurvey a county line, and one covering the Final Report of the ASCE Task Committee on the Status of Surveying and Mapping. A second plenary session will be held on Friday afternoon at which talks will be given on observations on surveying in Europe as noted during their visit to the FIG conference by President Williams and Vice President Bestor. At the Division Meeting on Thursday morning various matters pertinent to the Division will be discussed. A Business Meeting will be held on Thursday evening.

TOPOGRAPHY: Plans to have a member from the Geological Survey at the plenary session on Wednesday to speak on topographic mapping of that organization. In addition there will be a 2½ hour combined Division and business meeting covering matters of importance to the Division.

J. T. PILONERO
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